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Johnston Atoll Plutonium Cleanup Project Plant Modification and Operation
Volume 1—Annual Report Option Year 2

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13. ABSTRACT *(Maximum 200 words)*

This report continues the documentation of the operation of TMA/Eberline's Segmented Gate System technology for removing mixed plutonium and americium contamination at DNA's Johnston Atoll site. Contaminated feed is conveyed under arrays of radiation detectors coupled with sophisticated computer software developed by Eberline Instrument Corporation. Segmented gates (chutes) on pneumatically-driven pistons move forward when contamination is detected to remove only the contaminated portion from the main flow of feed material. Only about one pint of contaminant is removed during each diversion event. At the JA site, a 98% volume reduction has been achieved, with the remediated soil cleaned to DNA's criteria for release for unrestricted use of 500 Bq/kg total transuranic alpha contamination and no "hot" particles of greater than 5000 Becquerrels. The low level waste concentrate is expected to be packaged for shipment to an approved defense waste disposal site.

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SUMMARY

This is TMA/Eberline's (TMA's) third annual report to the Defense Nuclear Agency (DNA) for the Johnston Atoll (JA) Plutonium Soil Cleanup Project. TMA/Eberline is the prime contractor to DNA for the project. The report covers the period from October 1, 1992, through May 24, 1993, during the Option Year 2 period of the project. This report describes additional plant modifications and improvements accomplished during the period and presents the summarized results of plant soil processing.

TMA's Option Year 2 project objectives focused on further improving the soil processing plant and increasing soil process rates to achieve sustainable production yields. Plans were finalized to further extensively modify the plant by relocating two sorter belts from the supplementary soil washing system to the front end of the plant and setting them up as dry material Segmented Gate Systems similar to Units 1 and 2. DNA desired to accomplish the work cost-effectively and to isolate larger-sized feed material believed to have a significantly lower average plutonium activity and fewer "hot" particles than the minus 0.5-inch material that was being processed through Units 1 and 2. A cost-effective solution was found enabling the DNA Project Manager to borrow a portable rock crushing system from the U.S. Navy Construction Battalion (SeaBees). As a result, a relatively simple and independent plant layout for Units 3 and 4 was developed by Thermo Consulting Engineer (TCE), TMA's engineering subcontractor. TMA effectively implemented the major portion of these proposed plant modifications by the close of the Option Year 2 period. Section 2, PLANT MODIFICATIONS, details plant improvements and maintenance during the period.

Option Year 2 soil processing operations began on October 1, 1992, at the start of Fiscal Year 1993, and ended on May 24, 1993. At that time a separate "bridge" contract for soil processing operations was initiated. Plant operations are detailed in Section 3, PLANT PRODUCTION. Included are 40 figures displaying the results of detailed data analysis. Actual cleanup plant production for Option Year 2 began with soil processing on Units 1 and 2 on October 1, and continued until May 15, 1993. Soil sorting operations were accomplished on 110 days during the period. The total mass of contaminated soil processed by TMA's Segmented Gate Systems on Units 1 and 2 during the period exceeded 16,500 metric tons. Overall, the weight reduction achieved for all soil processed during the period was approximately 98.1%. Reported results are for feed soil excavated by DNA from the LE-2 area of the Radiological Controlled Area on JA.

TMA exceeded DNA's proposed production quota of less than 40% down time (equivalent to approximately 82.8 sorter processing hours per week or 60% of total available hours) for all weeks from the week of 20 February onward, except for the week of 17 April, based on 11.5 work hours per day over a 6-day week. Loss of production for that week was due to a 25-hour electrical power outage. The starting week of 20 February was chosen as

representing the beginning of full plant production after the first set of plant modifications.

TMA also exceeded DNA's proposed production goal of 900 metric tons per week for all weeks starting with the week ending 20 February onward, again with the exception of the week ending 17 April. Production and time utilization showed a generally increasing trend during the period, and was significantly greater for the second half of the period than for the first half. TMA effected this sustained daily production increase by effectively implementing DNA-approved plant improvements, staggering work shifts to start the work day earlier and work continuously through the lunch period, and successfully applying experience gained during the previous operating periods.

Records of detection and sorter assay of "hot" particles are generated and stored at the time that each particle is first identified by the detector and microprocessor circuits in the detector box. Record logs of evaluations of feed material for distributed radioactivity greater than 500 Bq/kg are generated every 20 seconds during soil processing. Over 450,00 individual records of soil sorting activity were recorded by the control room personal computer during the period. The maximum number of records generated by both units together was over 10,000 records in any one day.

Total radioactivity removed from contaminated feed material during the period exceeded 1,400,000 thousand Becquerels (kiloBecquerels), or the equivalent of approximately 0.6 grams of ^{239}Plutonium.

CONVERSION TABLE

Conversion factors for U.S. Customary to metric (SI) units of measurement.

MULTIPLY ---------->	BY ---------->	TO GET
TO GET <----------	BY <----------	DIVIDE
angstrom	1.000 000 X E -10	meters (m)
atmosphere (normal)	1.013 25 X E +2	kilo pascal (kPa)
bar	1.000 000 X E +2	kilo pascal (kPa)
barn	1.000 000 X E -28	meter^2 (m^2)
British thermal unit (thermochemical)	1.054 350 X E +3	joule (J)
calorie (thermochemical)	4.184 000	joule (J)
cal (thermochemical/cm^2	4.184 000 X E -2	mega joule/m^2 (MJ/m^2)
curie	3.700 000 X E +1	* giga becquerel (GBq)
degree (angle)	1.745 329 X E -2	radian (rad)
degree Fahrenheit	$t_K = (t°f + 459.67)/1.8$	degree kelvin (K)
electron volt	1.602 19 X E -19	joule (J)
erg	1.000 000 X E -7	joule (J)
erg/second	1.000 000 X E -7	watt (W)
foot	3.048 000 X E -1	meter (m)
foot-pound-force	1.355 818	joule (J)
gallon (U.S. liquid)	3.785 412 X E -3	meter^3 (m^3)
inch	2.540 000 X E -2	meter (m)
jerk	1.00 000 X E +9	joule (J)
joule/kilogram (J/kg) radiation dose absorbed	1.000 000	Gray (Gy)
kilotons	4.183	terajoules
kip (10000 lbf)	4.448 222 X E +3	newton (N)
kip/inch^2 (ksi)	6.894 757 X E +3	kilo pascal (kPa)
ktap	1.000 000 X E +2	newton-second/m^2 (N-s/m^2)
micron	1.000 000 X E -6	meter (m)
mil	2.540 000 X E -5	meter (m)
mile (international)	1.609 344 X E +3	meter (m)
ounce	2.834 952 X E -2	kilogram (kg)
pound-force (lbs avoirdupois)	4.448 222	newton (N)
pound-force inch	1.129 848 X E +2	newton-meter (N·m)
pound-force/inch	1.751 268 X E +2	newton/meter (N/m)
pound-force/foot^2	4.788 026 X E -2	kilo pascal (kPa)
pound-force/inch^2 (psi)	6.894 757	kilo pascal (kPa)
pound-mass (lbm avoirdupois)	4.535 924 X E -1	kilogram (kg)
pound-mass-foot^2 (moment of inertia)	4.214 011 X E -2	kilogram-meter^2 (kg·m^2)
pound-mass-foot^3	1.601 846 X E +1	kilogram/meter^2 (kg-m^3)
rad (radiation dose absorbed)	1.000 000 X E -2	** Gray (Gy)
roentgen	2.579 760 X E -4	coulomb/kilogram (C/kg)
shake	1.000 000 X E -8	second (s)
slug	1.459 390 X E +1	kilogram (kg)
torr (mm Hg, O°C)	1.333 22 X E -1	kilo pascal (kPa)

*The becquerel (Bq) is the SI unit of radioactivity: 1 Bq = 1 event/s.

**The Gray (GY) is the SI unit of absorbed radiation.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

FIGURES

FIGURES (Continued)

SECTION 1

INTRODUCTION

1.1 GENERAL.

This is TMA/Eberline's (TMA's) third annual report to the Defense Nuclear Agency (DNA) for the Johnston Atoll (JA) Plutonium Soil Cleanup Project. The report covers the period from October 1, 1992, through May 24, 1993, during the Option Year 2 period of the project. This report describes additional plant modifications and improvements accomplished during the period and presents the summarized results of plant soil processing. Duplication of material previously presented in TMA's two prior reports was minimized. The reader is referred to these reports ([1]TMA, 1992 and [2]TMA, 1993) for detailed information regarding the project's scope, objectives, operational methodology, historical background, and prior soil sorting results.

1.2 OPTION YEAR 2 OBJECTIVES.

TMA's Option Year 2 project objectives focused on further improving the soil processing plant and increasing soil process rates to achieve sustainable production yields in accordance with the Statement of Work. Improvements to the soil cleanup plant are discussed in Section 2, OPTION YEAR 2 PLANT MODIFICATIONS, of this report. Results of soil processing during the period are presented in Section 3, PLANT PRODUCTION.

1.3 TMA/EBERLINE.

TMA/Eberline is the prime contractor to DNA for the project. TMA/Eberline is a division of Thermo Analytical, Incorporated, a subsidiary of Thermo Instrument Systems. Thermo Analytical was rated as the nation's #2 Mixed Waste Analytical Contractor and the #6 Environmental Analytical Contractor by the professional journal Environment Today in March, 1992. Thermo Instrument Systems is one of the world's largest companies specializing in environmental monitoring and laboratory instrumentation with revenues of $243 million for the fiscal year ending January 2, 1993. The company develops, manufactures, and markets analytical instruments used to detect and monitor air pollution, radioactivity, complex chemical compounds, toxic metals, and other elements in a broad range of matrices. The company also provides environmental science and engineering services, laboratory analytical services, and health physics services. TMA/Eberline specializes in these last two services.

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1 Johnston Atoll Plutonium Cleanup Project Annual Report, Base Period: Plant Modification, Performance Testing, and Operation, TMA/Eberline, Thermo Analytical, Inc., Preliminary Draft; October 15, 1992.

2 Johnston Atoll Plutonium Cleanup Project Annual Report, Option Year 1: Plant Modification, Performance Testing, and Operation, TMA/Eberline, Thermo Analytical, Inc., Final Report, November 23, 1992.

TMA employs a staff of approximately 525 persons, including professional chemists, radiochemists, ecologists, toxicologists, biologists, health physicists, and industrial hygienists, as well as experienced laboratory and field monitoring technicians. The TMA division assigned lead responsibility for the JA Plutonium Contaminated Soil Cleanup Project is TMA/Eberline.

TMA's Health Physics Services group is comprised of a team of experienced individuals able to plan and implement a wide variety of tasks requiring protection for workers and the environment from radiological, industrial hygiene and safety hazards.

TMA's extensive corporate experience supports nuclear services that include project management, radiological assessment and evaluation, training, radiological and chemical site characterization, remedial action, instrument maintenance and repair, environmental and personnel dosimetry, NRC licensing, industrial hygiene, health and safety, nuclear utility support, and research and development.

SECTION 2

OPTION YEAR 2 PLANT MODIFICATIONS

2.1 PLANNED MODIFICATIONS.

TMA previously made significant modifications to the Plutonium Soil Cleanup Plant during Option Year 1 in an effort to enhance operations and increase production. Most of this effort centered around moving the second sorting system from its former location at the end of the soil washing area to a tandem location parallel to soil Sorter 1 (see Figure 2-1, Option Year 1 Plant Layout). TMA completed modification, installation, and testing of this second Segmented Gate System within the abbreviated Option Year 1 period that was approximately 3 months in length. These modifications are described in detail in TMA's Option Year 1 Report (TMA, 1993).

Other modifications required to fully implement these alterations extended into Option Year 2. These included installing an eddy current drive system at the former location of Unit 2 on the "wet" end; and design, fabrication, and installation of a belt wiper for this location (the pneumatic belt wiper was relocated to the new Unit 2 location). These modifications were necessary in order to be able to operate the flat conveyor belt at the end of the supplementary ("wet end") soil washing system to convey washed material to a location where it could be removed with heavy equipment. TMA also completely enclosed the housing and removed excess or intruding metal pieces for the Segmented Gate Systems on Units 1 and 2 to reduce the possibility of windblown contaminated material ("hot" particles) migrating into the clean path when feed material is conveyed over the ends of the sorting belts. TMA accomplished these modifications during the months of October and November when unusually heavy rains often made the soil too wet to process through the plant.

As these modifications were completed, plans were finalized to further extensively modify the plant by relocating the "wet" end sorter belts to the front end of the plant and setting them up as dry material Segmented Gate Systems similar to Units 1 and 2. In consultation with TCE, TMA proposed several plant layouts to DNA to integrate the proposed sorting Units 3 and 4 with Units 1 and 2 that utilized inexpensive used equipment identified in the commercial marketplace. However, DNA desired to accomplish the work at even lower cost and to isolate larger-sized feed material which is believed to have a significantly lower average plutonium activity and fewer hot particles from the minus 0.5-inch material that was being processed through Units 1 and 2. A cost-effective solution was found enabling the DNA Project Manager to borrow a portable rock crushing system from the U.S. Navy Construction Battalion (SeaBees). As a result, a relatively simple and independent plant layout for Units 3 and 4 was developed by TCE (TMA's engineering subcontractor). A proposed plant layout drawing is shown in Figure 2-2, Proposed Plant Revisions for

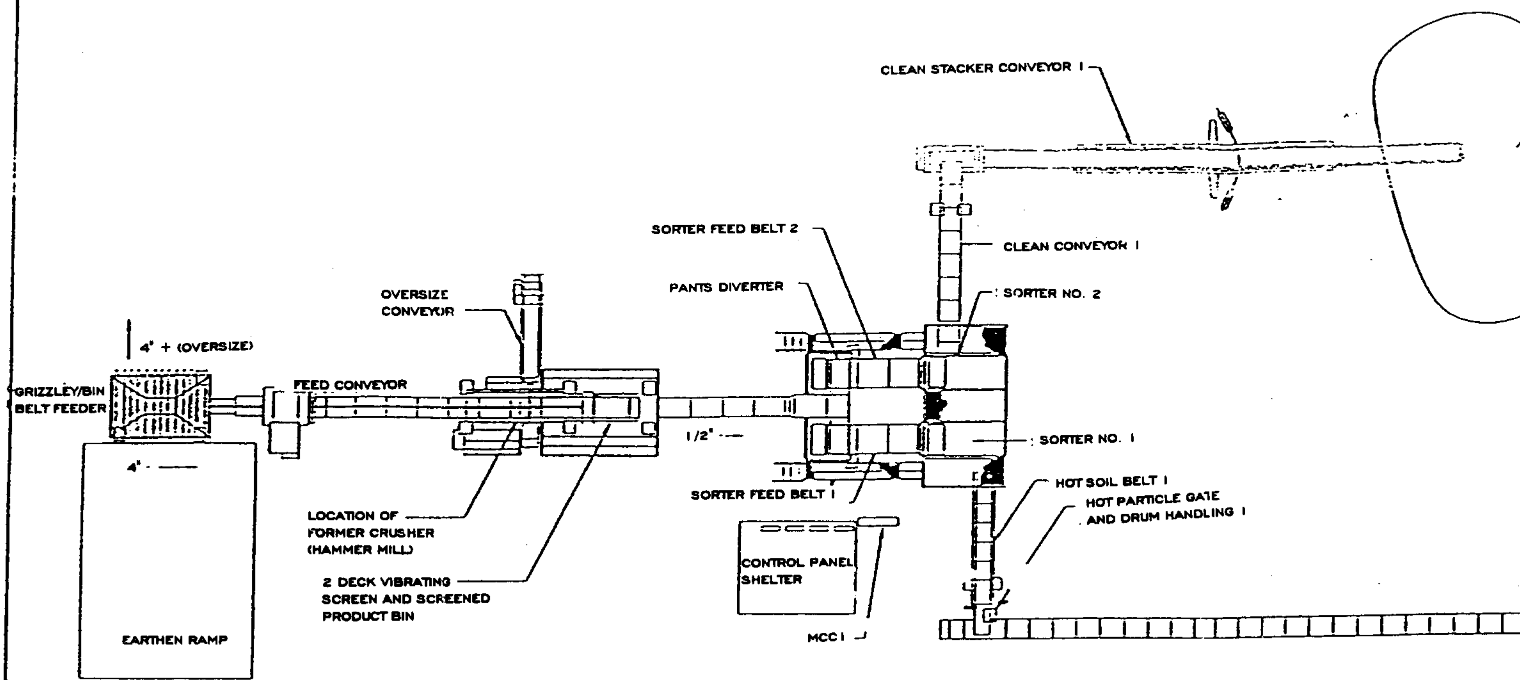

Figure 2-1. Option year 1 plant layout.

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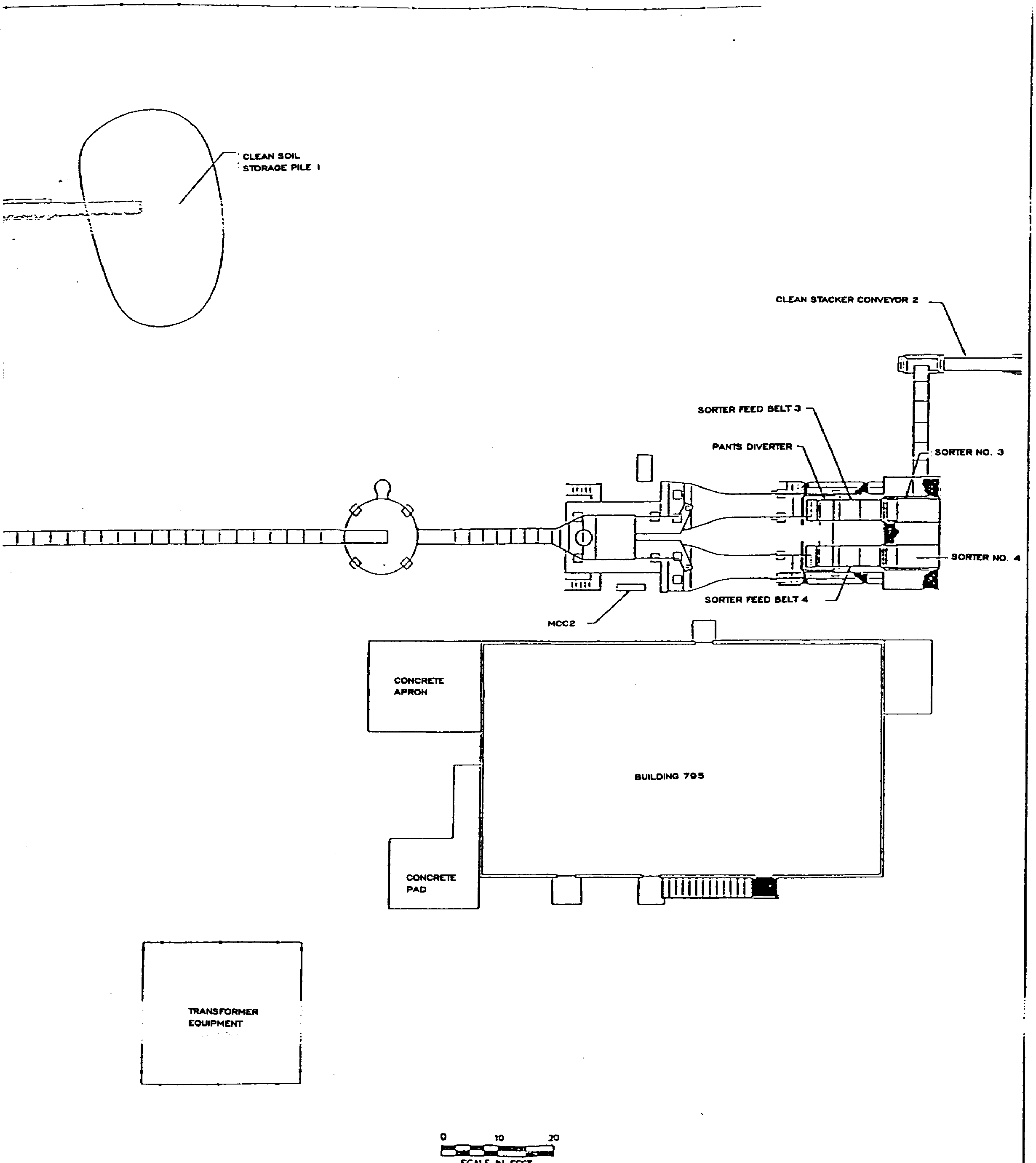
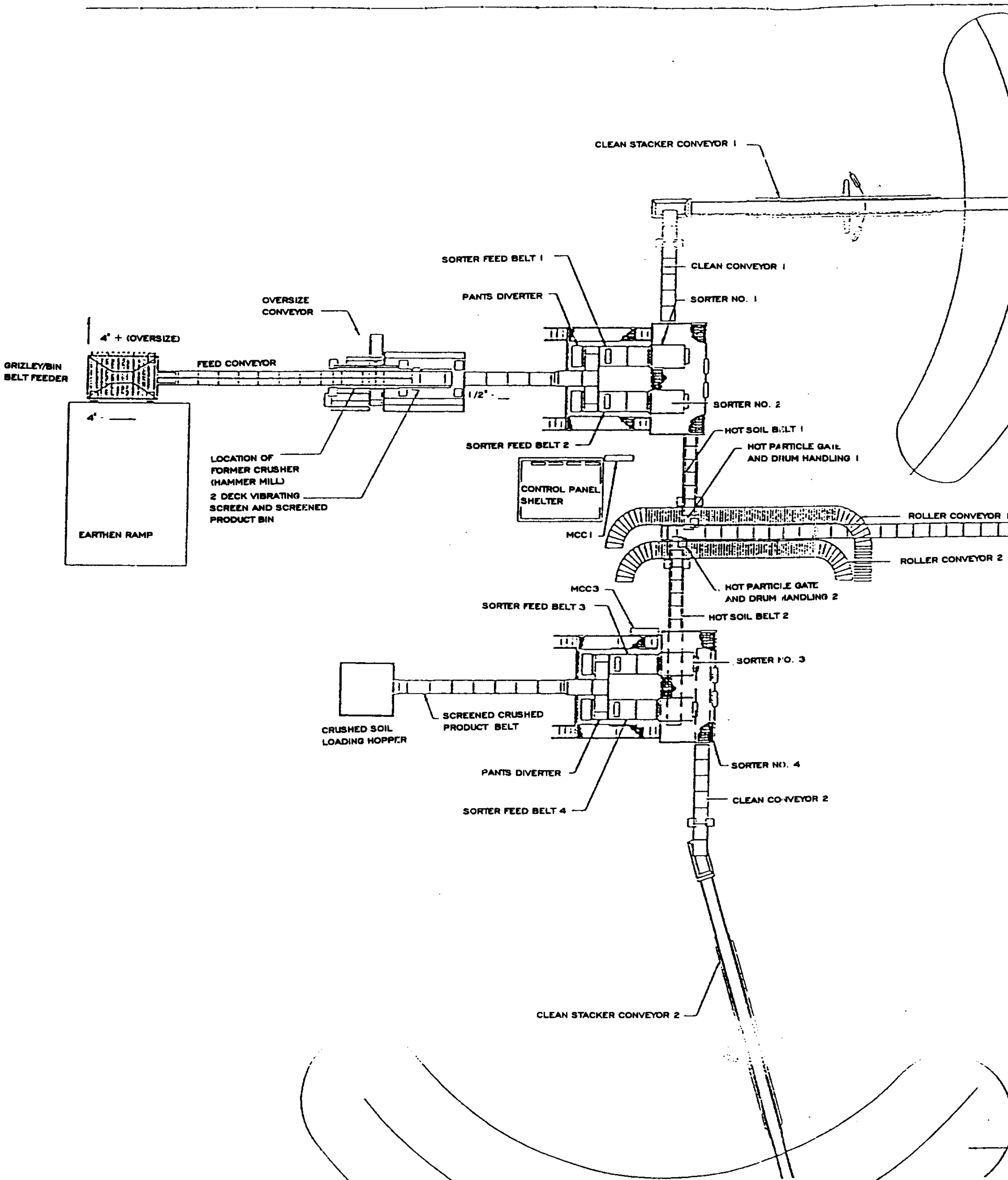


DRAWN	CHECKED	FILENAME: ALL-FLOW	Thermo Consulting Engineers	JOHNSTON ATOLL PLUTONIUM SOIL CLEANUP EXISTING EQUIPMENT LAYOUT	DESIGNED DRAWN CHECKED (PW) CHECKED (PE) SCALE DATE	PROJECT NO. 2V085 DRAWING NO. SHEET OF



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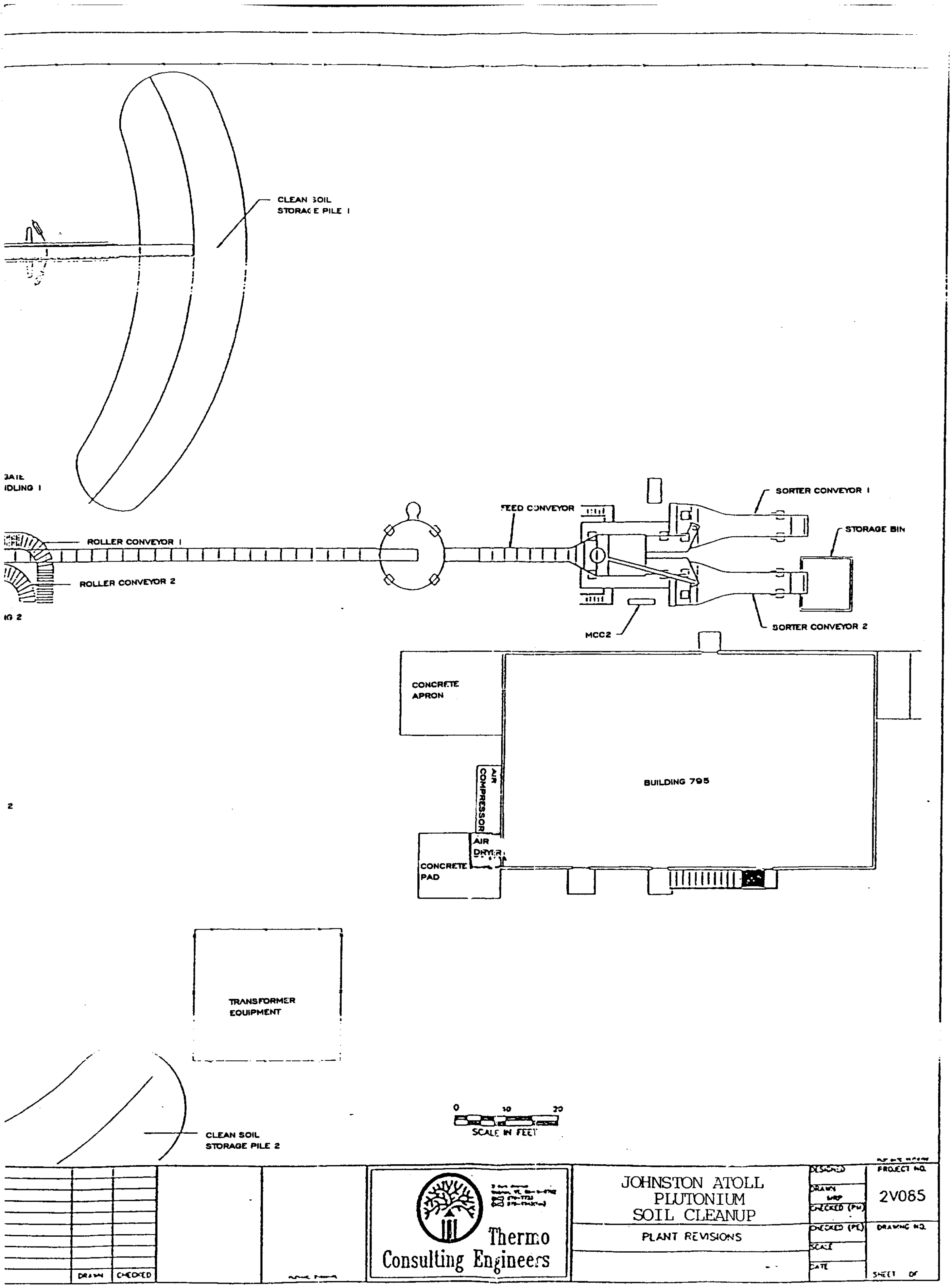


Figure 2-2. Option year 2 proposed plant revisions.

Option Year 2. The plant layout as built at the end of Option Year 2 is shown in Figure 2-3, Option Year 2 Plant Revisions As Built. Departures from the planned layout at the time of developing this report included the following:

- Roller Conveyor #2 - at present no additional roller conveyor has been procured nor does it appear to be necessary until the units have undergone full production testing.

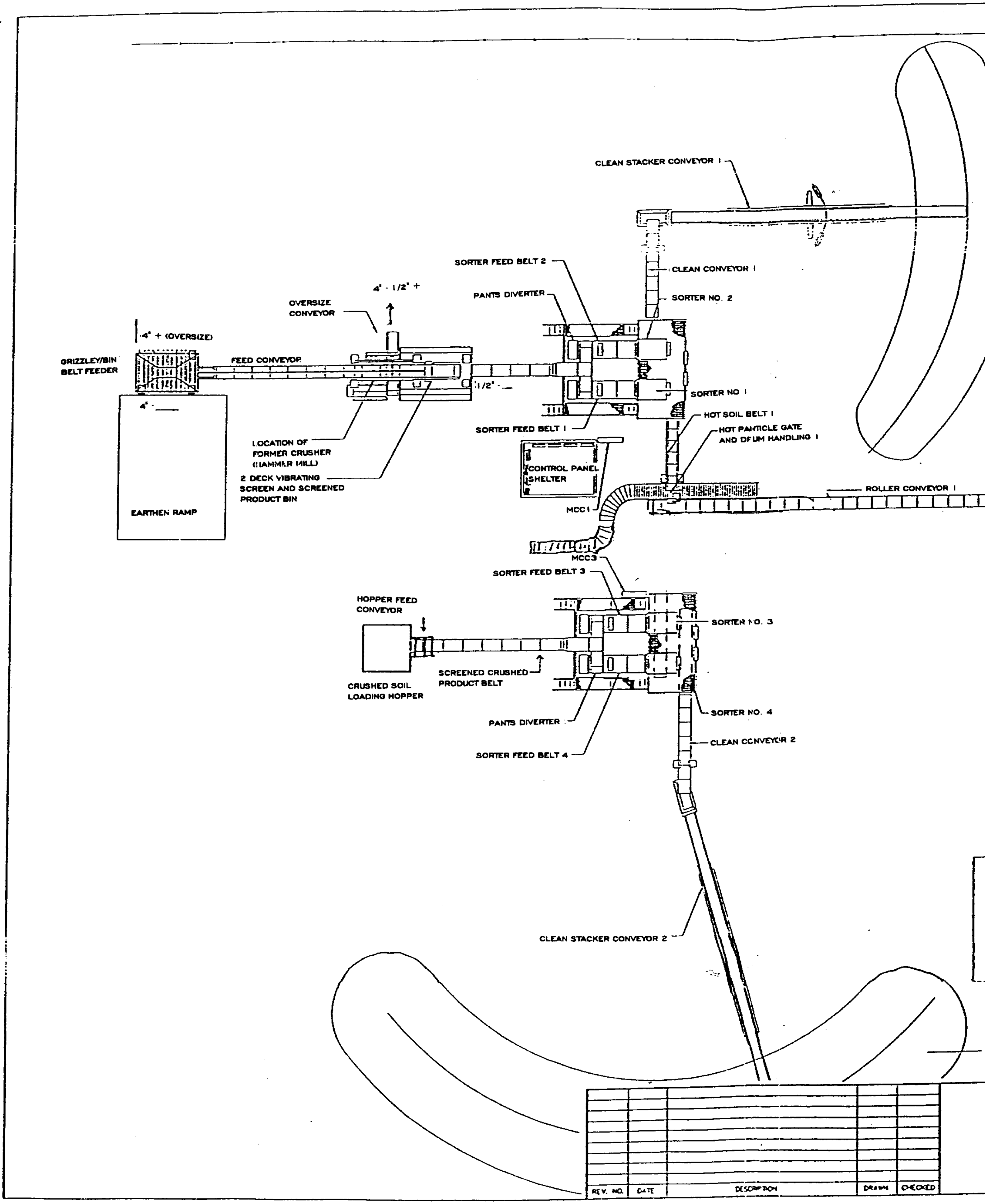
- Hot Soil Belt #2 - the conveyor that is needed for this location is approximately 34 feet long. The conveyor that arrived on island is 60 feet long and TMA was directed that it was not to be modified. In order to meet the direction to demonstrate a working system this belt was not emplaced and instead barrels are used to catch contaminated soil. This interim solution is workable only so long as very little activity is diverted. If significant contamination similar to that seen on units 1 and 2, the operators will not be able to physically keep up with the conveyor system and it will then require manual shutdown. It is expected that permission to shorten the conveyor belt will be obtained in the near future and if so it will be modified and installed.

- Hopper Feed Conveyor - a short 10 foot feed conveyor was installed under the crushed soil loading hopper which in turn feeds the screened crushed product belt. This modification allows greater control of feed material to Units 3 and 4.

- Storage Bin - at the end of Option Year 2, no formal storage bin has been constructed at the end of screw conveyor 2. To date none has appeared to be necessary, but should it become advantageous to do so one can be fabricated with materials on-island.

The individual tasks that were required to implement the move of Units 3 and 4 from their former location to that shown in Figure 2-3 are shown in Table 2-1, Task Summary.

In addition to those tasks shown in Table 2-1, an expansion of the control room was required to accommodate additional computer equipment, belt scales and other equipment to be employed with the new Units 3 and 4. Control room modifications were primarily performed by RSN, the on-island support contractor, and were completed the week ending January 17, 1993. TMA installed conduit and wiring for fiber optic signal cables from the new units to a second control room personal computer, and conduit for signal cable and direct current (DC) power to the new conveyor belt scales.


CLEAN STACKER CONVEYOR 1
SORTER FEED BELT 2
CLEAN CONVEYOR 1
PANTS DIVERTER
SORTER NO. 2
OVERSIZE CONVEYOR
4" - 1/2" +
4" + (OVERSIZE)
GRIZZLEY/BIN BELT FEEDER
FEED CONVEYOR
1/2" -
SORTER NO 1
4" -
HOT SOIL BELT 1
SORTER FEED BELT 1
HOT PARTICLE GATE AND DRUM HANDLING 1
LOCATION OF FORMER CRUSHER (HAMMER MILL)
CONTROL PANEL SHELTER
2 DECK VIBRATING SCREEN AND SCREENED PRODUCT BIN
ROLLER CONVEYOR 1
EARTHEN RAMP
MCC1
MCC3
SORTER FEED BELT 3
HOPPER FEED CONVEYOR
SORTER NO. 3
SCREENED CRUSHED PRODUCT BELT
CRUSHED SOIL LOADING HOPPER
PANTS DIVERTER
SORTER NO. 4
CLEAN CONVEYOR 2
SORTER FEED BELT 4
CLEAN STACKER CONVEYOR 2
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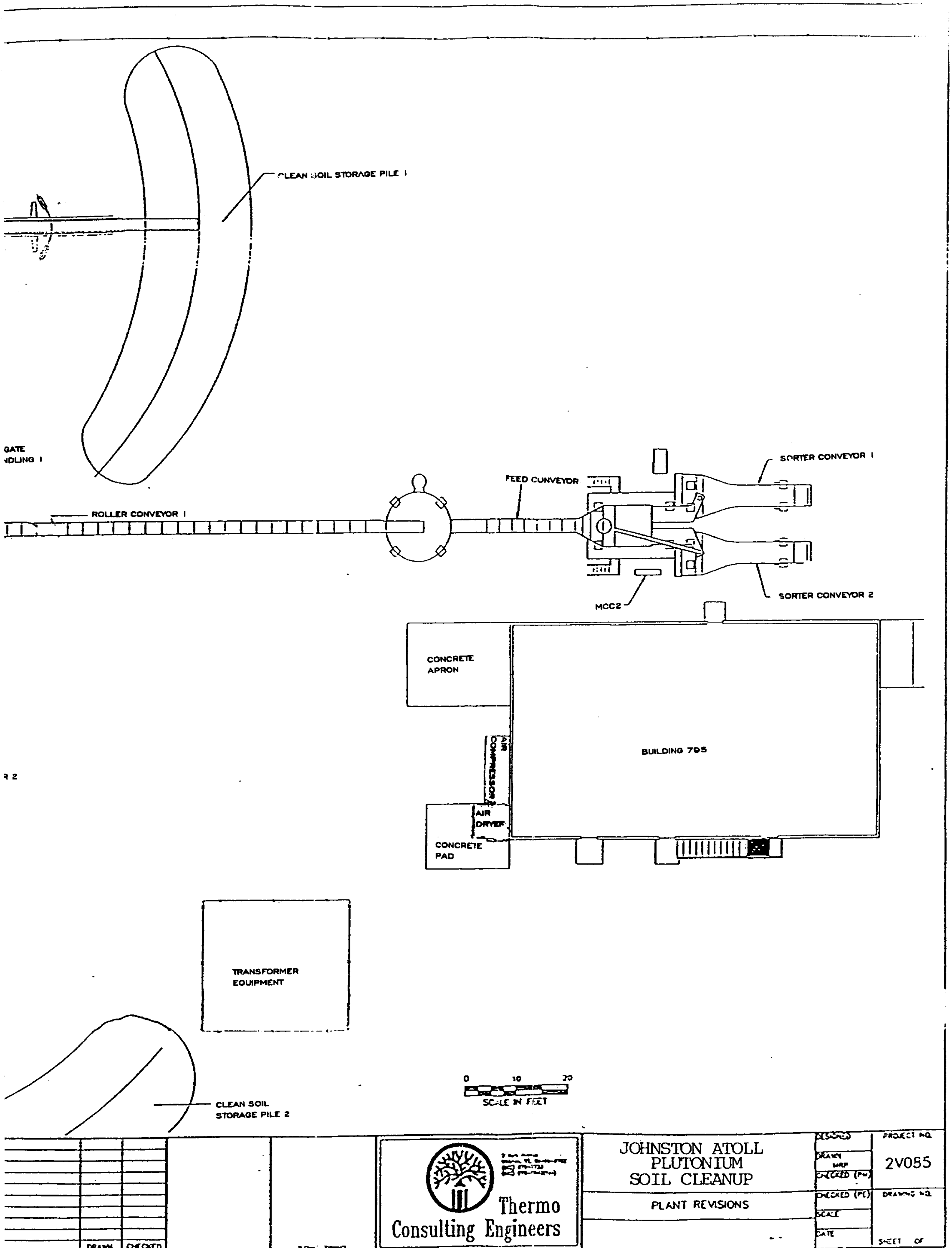

Figure 2-3. Option year 2 plant revisions as built.

Table 2-1. Task Summary.

FEBRUARY
TRENCH AND PLACE ELECTRICAL AND DATA LINE CONDUIT
INSTALL AIR SAMPLER/UTILITY 110 V CIRCUITS
REWIRE MOTOR CONTROL CENTER PANEL
DESIGN FEE HOPPER
FABRICATE FEED HOPPER
REVIEW PUMP SELECTION, SERVICE, CLEAN, AND PAIN PUMPS
INVENTORY SORTER EQUIPMENT
INSTALL ELECTRICAL WIRING TO SORTER GATES AND RELAY BOXES
INSTALL ONHAND ROLLERS ON UNITS 3 & 4
MOUNT VARIABLE SPEED DRIVES
INSTALL DRIVE MOTOR MOUNTS ON UNITS 3 & 4
INSTALL DRIVE MOTORS ON UNITS 3 & 4
MODIFY UNIT 3 & 4 GATE CHUTES
INSTALL CHUTE LINERS ON UNITS 3 & 4
FABRICATE AND INSTALL SORTER GATE DOOR COVERS UNIT 3 & 4
REPROGRAM SPEED CONTROLLER ON UNIT 2

MARCH
CLEAN WET END CLASSIFIER (r.h. UNIT)
SERVICE WET END CLASSIFIER (r.h. UNIT)
DESIGN CONVEYOR CHEAT PLATE
FABRICATE CONVEYOR CHEAT PLATE
INSTALL PLUMBING TO NEW POND
INSTALL ADDITIONAL DISTRIBUTION PLUMBING BETWEEN PONDS
WIRE POND PUMP AT NEW LOCATION
INSTALL ADDITIONAL FLOW METER
DISASSEMBLE AND REINSTALL DENSITY FLOW METER
CONNECT FLOW METERS TO MONITORS
OPERATE WET END - WATER FLOW ONLY
ADJUST WET END AND SET FLOW METERS
OPERATE WET END IN PRODUCTION MODE
COMPLETE BINDICATOR ELECTRICAL WIRING
CLEAN, SERVICE AND REPLACE CLEAN STACKER ROLLERS 3 & 4
INSTALL ELECTRICAL WIRING FOR DRIVE MOTORS 3 & 4
INSTALL ELECTRICAL WIRING TO WEIGH SCALES
MOUNT SORTER GATES ON UNITS 3 & 4
FABRICATE BI-FOLD MATERIAL FEED DIVERTER CHUTE
INSTALL CONVEYOR BELT SCALES
ADJUST CONVEYOR SPEEDS
DESIGN CONTAMINANT CHUTE
INSTALL DETECTOR BOXES
INSTALL DETECTOR ELECTRIC BOXES
INSTALL DETECTOR SYSTEMS

Table 2-1. Task Summary (Continued).

INSTALL FIBER OPTIC CABLES AND MODEMS
INSTALL 120 VAC TO SORTERS 3 7 4
INSTALL UPS TO UNITS 3 & 4
BRING NEW AIR DRYER SYSTEM ON LINE
MODIFY EXISTING DIVERTER CHUTE DESIGN
DESIGN SUPPORT FRAMEWORK/COLLARS FOR SURGE FEED BINS
DESIGN VIBRATION DAMPER FOR DIVERTER CHUTE
FABRICATE FRAMEWORK/COLLARS FOR SURGE FEED BINS
INSTALL VIBRATOR DAMPER FOR DIVERTER CHUTE
MOUNT PANTSLEG DIVERTER CHUTE
INSTALL ROLLERS FOR UNIT 4
MODIFY FEED CONVEYOR
MODIFY CONVEYOR FOOTINGS
SET FEED CONVEYOR
ASSEMBLE AND PLACE FEED HOPPER (Including added feeder conveyor)
MODIFY, ASSEMBLE, AND INSTALL CONTAMINATE CONVEYOR
MOUNT ENTIRE PLANT TO FOUNDATION
SET CONTAMINANT CONVEYOR
PERFORM MECHANICAL SYSTEM CHECKOUT
SET UP NEW COMPUTER IN CONTROL ROOM
INITIATE COMMUNICATIONS TO NEW COMPUTER
FABRICATE NEW ROLLERS FOR BELT SCALES
TEST NEW COMPUTER/PRINTER COUNT SYSTEM OPERATIONS
PERFORM COUNTING SYSTEM CHECKOUT
CALIBRATE COUNTING SYSTEM
TIME SORTING SYSTEM TO CONVEYOR BELTS
PERFORM CHECKOUT OF ENTIRE SYSTEM
INSTALL # 1 WIRE TO MOTOR CONTROL CENTER 3
INSTALL WIRING FROM MOTOR CONTROL CENTER 3 TO UNITS 3 & 4

APRIL
TROUBLESHOOT PROBS. IDENTIFIED DURING CHECKOUT OF 3 & 4
PERFORM REPAIRS ON 3 & 4 AS REQUIRED
SUBMIT MECHANICAL OPERATING PROCEDURE REVISION
OPERATE ALL UNITS FOR SOIL PROCESSING
INCORPORATE COMMENTS TO BASE YEAR REPORT AND SUBMIT
INCORPORATE COMMENTS TO OPTION YEAR 1 REPORT AND SUBMIT
INCORPORATE COMMENTS TO DECOMMISSIONING PLAN AND SUBMIT
INVENTORY AND ORGANIZE ON-HAND SPARE PARTS
APPLY PRIMER TO NEW METALWORK
APPLY PAINT TO NEW METALWORK
INSTALL FEED CONVEYOR COVERS
OPERATE UNITS 1 AND 2 AS POSSIBLE
OPERATE WET END AS NECESSARY

MAY
OPERATIONS AS REQUIRED
PLAN FOR DEMOBILIZATION AS REQUIRED

An additional task was performed to install a liner on a new pond excavated by RSN at DNA's direction to facilitate operation of the supplemental soil washing system. TMA personnel assembled the pond liner and directed the installation process with the help of approximately 20 volunteers solicited by DNA from the on-island U.S. Army Military Police (MP) Company.

2.2 PLANT MECHANICAL MAINTENANCE.

2.2.1 Startup and Shutdown.

In general, physical plant maintenance requires approximately 30 minutes each morning to perform checks on mobile and stationary heavy equipment. Approximately 30 minutes of maintenance is required after plant shutdown to check bins and chutes for material build-up and cleaning as necessary. When soil is processed with higher than normal moisture, additional build-up occurs and additional time is required to remove the material.

2.2.2 Other Routine Maintenance.

TMA generally scheduled other routine maintenance on Saturday afternoons. At this time bearings were lubricated, lubrication well levels were checked, and minor repairs and corrosion control was scheduled and implemented as required. TMA maintains records of routinely scheduled equipment maintenance on JA.

2.2.3 Maintenance Problems.

During Option Year 2, two mechanical plant maintenance problems were of special concern. These included overheating problems with the Unit 2 drive control motor and problems maintaining calibration of the conveyor belt weigh scales.

2.2.3.1 Unit 2 Motor Overheating Problems. Following problems encountered in Option Year 1 involving motor overheating on Unit 2, the motor speed control unit manufactured by Danfoss Company was sent back to the factory for inspection and repair. The drive was returned to JA on October 1, 1992. Danfoss indicated they had found no problems with the unit. Over the next several months the motor on Unit 2 occasionally overheated when run for periods in excess of 8 hours. It was felt that the fault lay in the motors themselves, and the motor was changed and bearings replaced on two occasions. In March 1993, motor overheating occurred again and the new motor controller for Unit 3 was exchanged for that of Unit 2. The system then operated successfully according to design specifications. The Unit 2 motor controller was again returned to Danfoss for evaluation. When again no problem was detected by Danfoss, TCE requested an extended test over a 12 hour period. This test revealed that a component in the drive had failed. The unit was repaired by Danfoss at no cost and returned to the island.

2.2.3.2 Belt Weigh Scales. During October and November, 1992, it became clear that the belt scales for process Units 1 and 2 behaved erratically. Numerous attempts were made to recalibrate these scales following telephone instructions from the vendor. These attempts were not successful, and it was decided to bring a factory representative to the island for a one week period to perform calibration, verify the scale installation, and train on-island personnel in both of these areas. Prior to arrival of the service representative, the vendor (Reide Scales) recommended that the conveyor belts with belt scales in place should be slowed down in order to increase the amount of material loading on the belts. This change required several days to implement. Motor sheaves and reduction sheaves were replaced, and new drive belts were installed. New drive belt covers were fabricated by RSN. The belt scales were completely reinstalled at Reide's direction. They were then recalibrated by Reide's factory technician the week of November 16, and results compared to another calibrated scale at the JA airfield. Conveyor belt weigh scales have subsequently performed in a consistent and expected manner.

SECTION 3

PLANT PRODUCTION

3.1 PLANT PRODUCTION DURING OPTION YEAR 2.

Option Year 2 operations began on October 1, 1992, at the start of Fiscal Year 1993, and ended on May 24, 1993. At that time a separate "bridge" contract for soil processing operations was initiated. Actual cleanup plant production for Option Year 2 began with soil processing on Units 1 and 2 on October 1, and continued until May 15, 1993. Soil sorting operations were accomplished on 110 days during the period, and a total of approximately 16,500 metric tons of contaminated feed material were processed.

Total daily processed mass in metric tons is shown in Figure 3-1, Daily Processed Mass, Units 1 and 2 Combined. Cumulative production is shown in Figure 3-2, Option Year 2 Cumulative Production. The total mass of contaminated soil processed by TMA's Segmented Gate Systems on Units 1 and 2 during the period exceeded 16,500 metric tons. The JACC computer software calculated the data. TMA staff summarized the data using the DNA-provided Symphony spreadsheet developed by Dr. Edward T. Bramlitt, and analyzed and charted it using Microsoft's Excel 4.0. Calculated mass is based on each day's operator-selected feed material density.

3.2 WEIGHT REDUCTION.

Overall, the weight reduction achieved for all soil processed during the period was approximately 98.1%. The amount of weight reduction achieved by the cleanup plant is primarily dependent on the amount of radioactivity present in the feed material. Reported results are for feed soil excavated by DNA from the LE-2 area of the Radiological Controlled Area on JA. The total daily percent weight reduction combined for Units 1 and 2 is shown in Figure 3-3, Daily Percent Weight Reduction. The total daily processed mass of feed material for both units is compared to the corresponding daily weight reduction in Figure 3-4, Daily Processed Mass and Weight Reduction.

3.3 TIME UTILIZATION.

Figures 3-5 and 3-6, Daily Percent Time Utilization (Units 1 and 2, respectively), display the percent time utilization for each sorter system for each process day. The number of actual daily process hours for Units 1 and 2, respectively, is shown in Figures 3-7 and 3-8, Daily Process Hours, Sorter 1 and Sorter 2. Daily and cumulative production combined for both units is presented in Figure 3-9, Plant Daily and Cumulative Production. Figures 3-10 and 3-11, Unit 1 Hours to Startup and Shutdown,

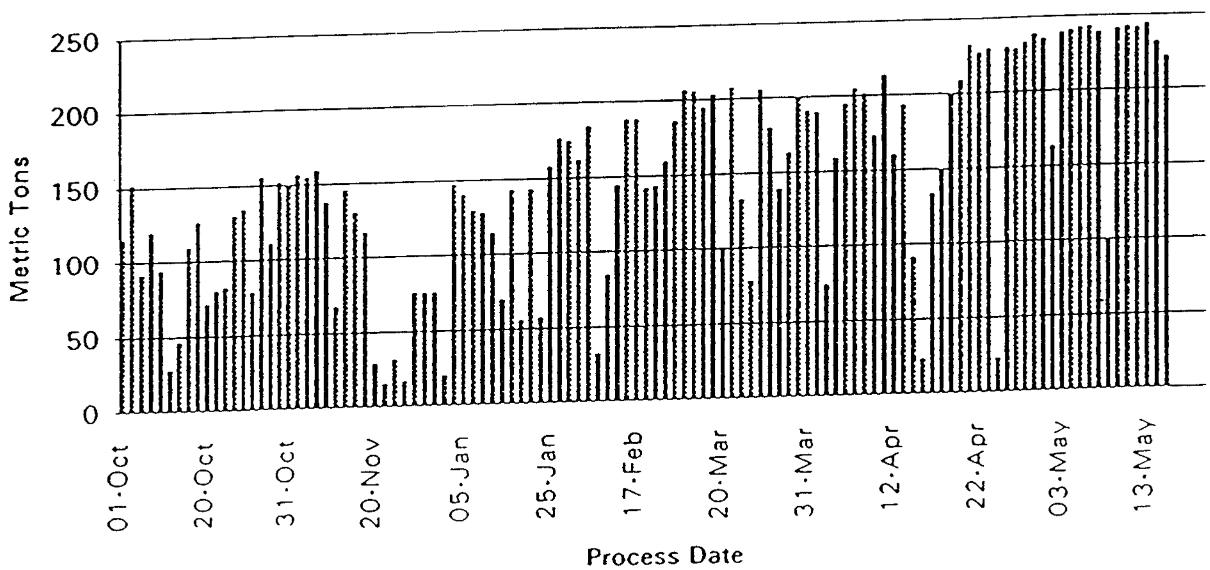

Figure 3-1. Daily processed mass, units 1 and 2 combined.

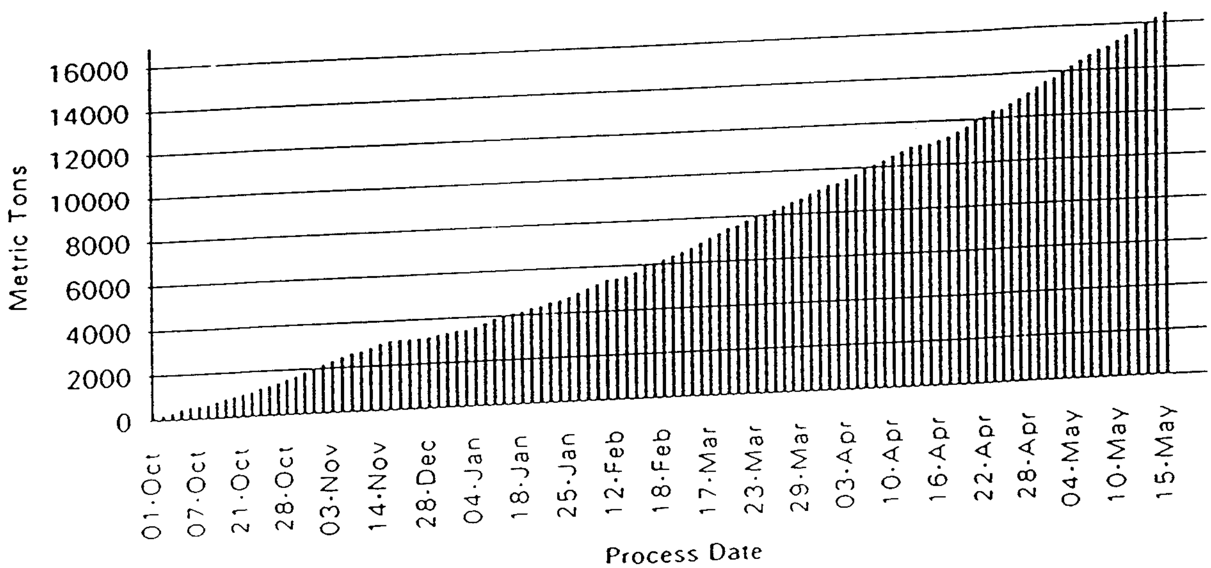

Figure 3-2. Option year 2 cumulative production.

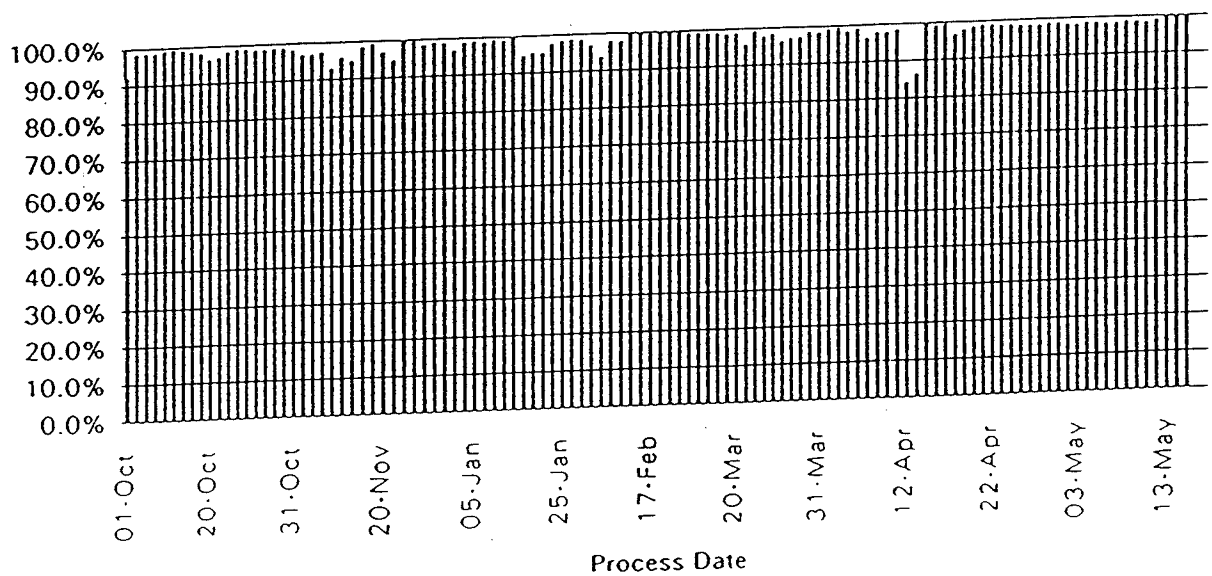

Figure 3-3. Daily percent weight reduction.

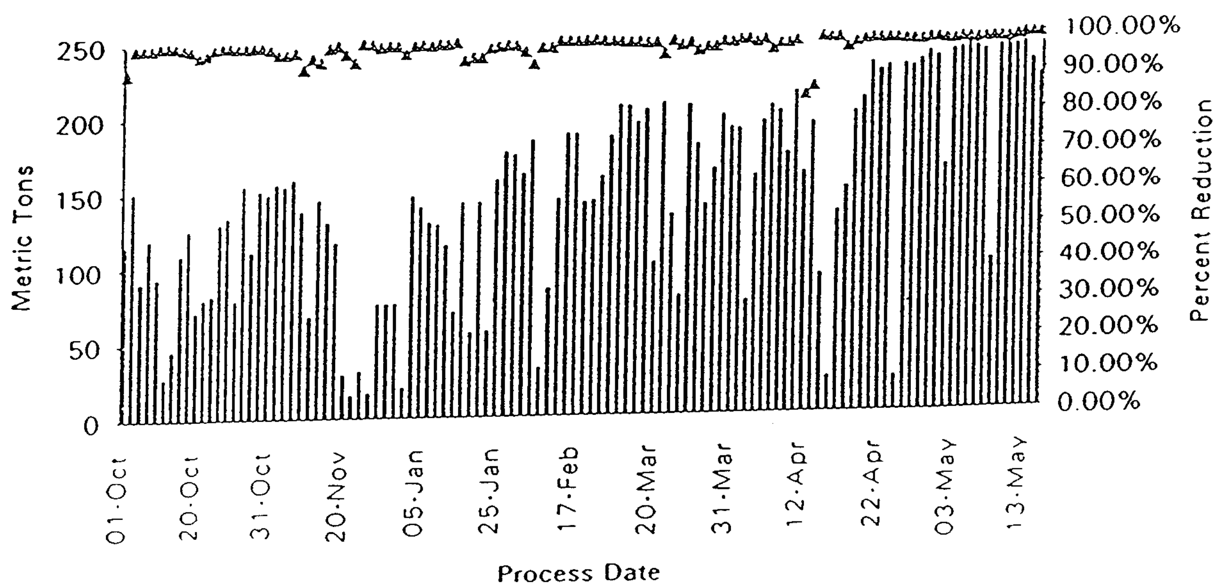

Figure 3-4. Daily processed mass and weight reduction.

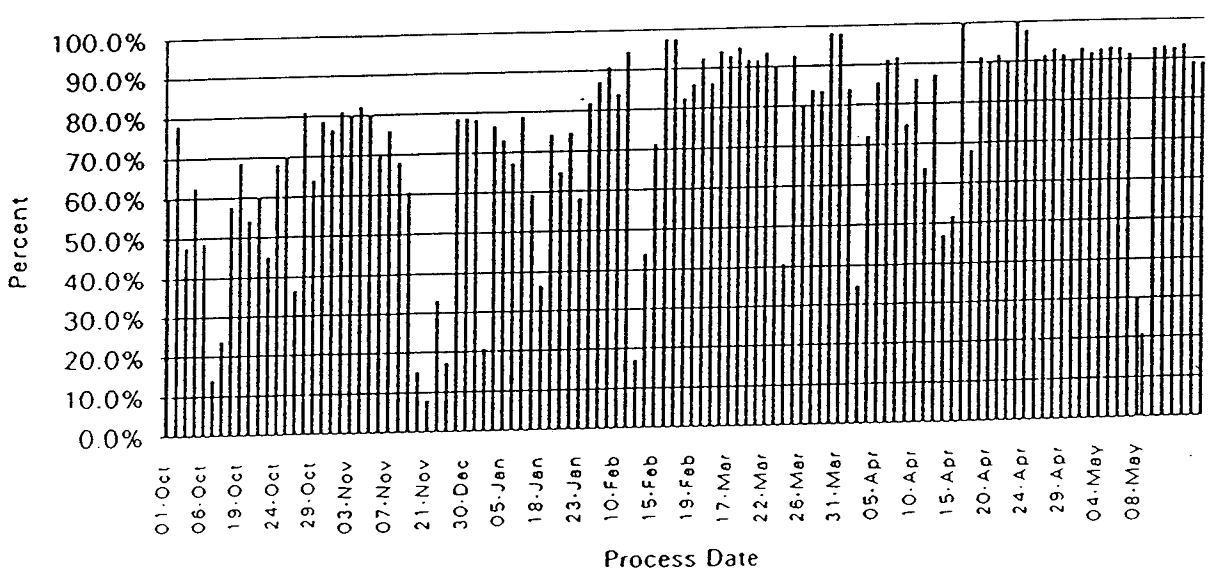

Figure 3-5. Daily percent time utilization, sorter 1.

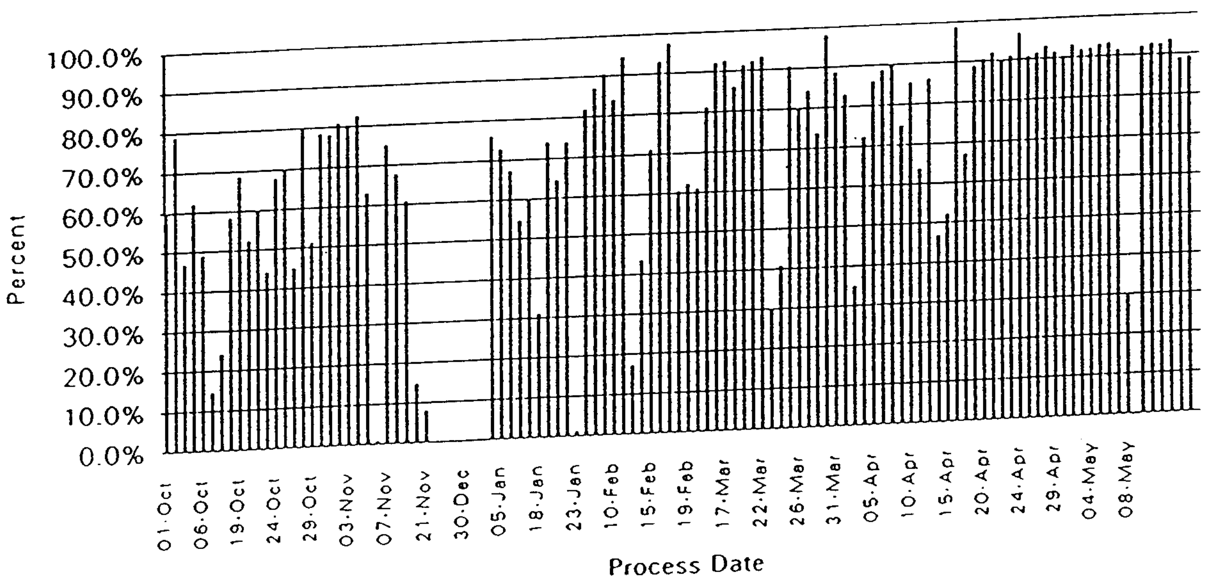

Figure 3-6. Daily percent time utilization, sorter 2.

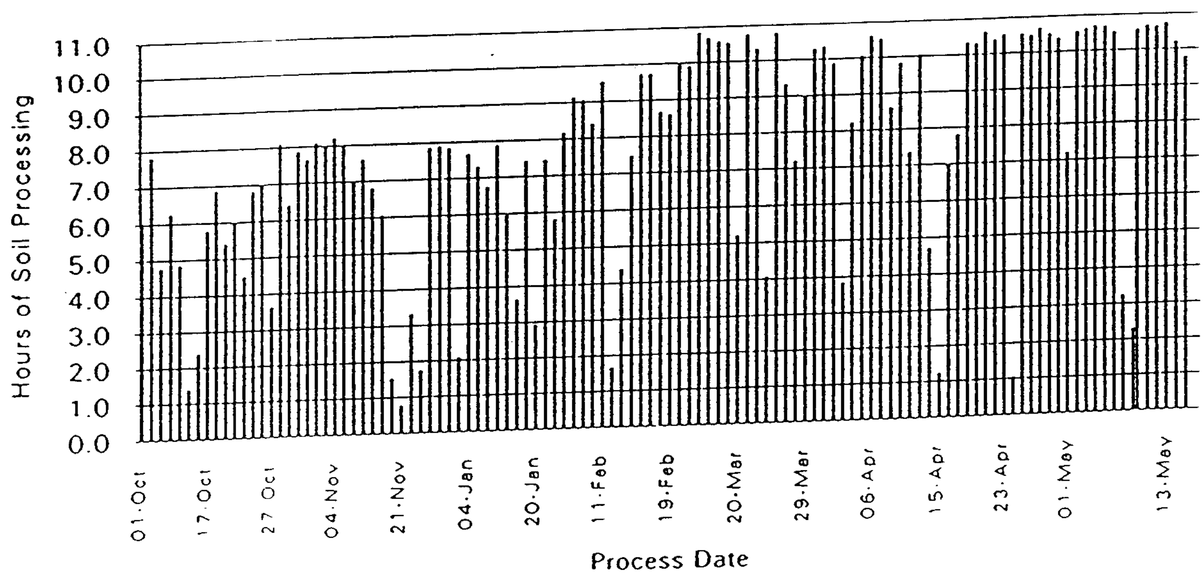

Figure 3-7. Daily process hours, sorter 1.

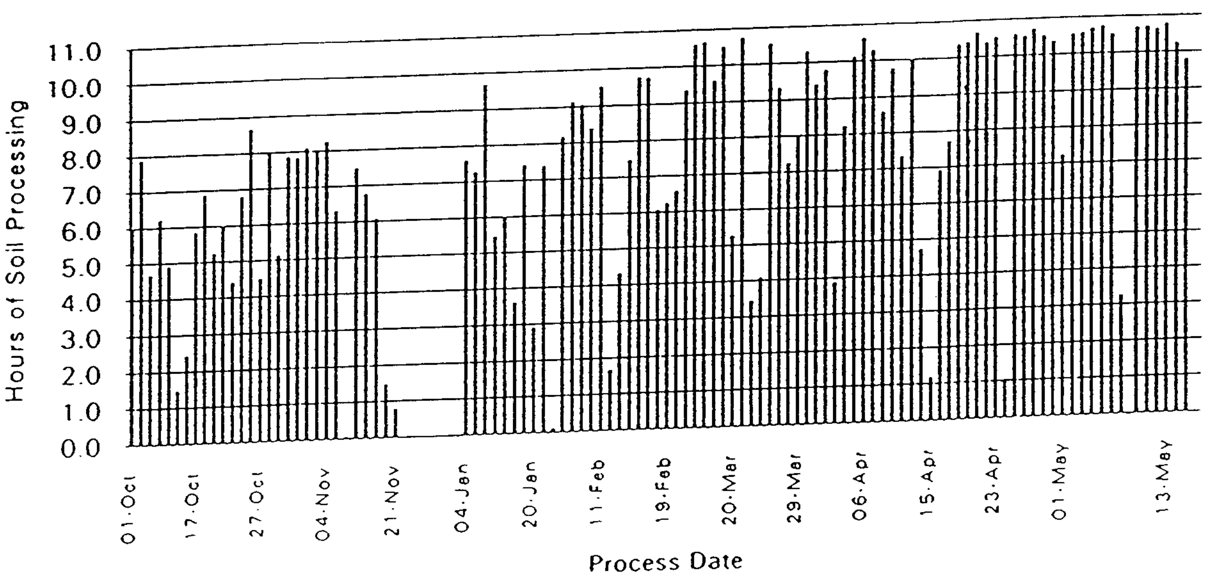

Figure 3-8. Daily process hours, sorter 2.

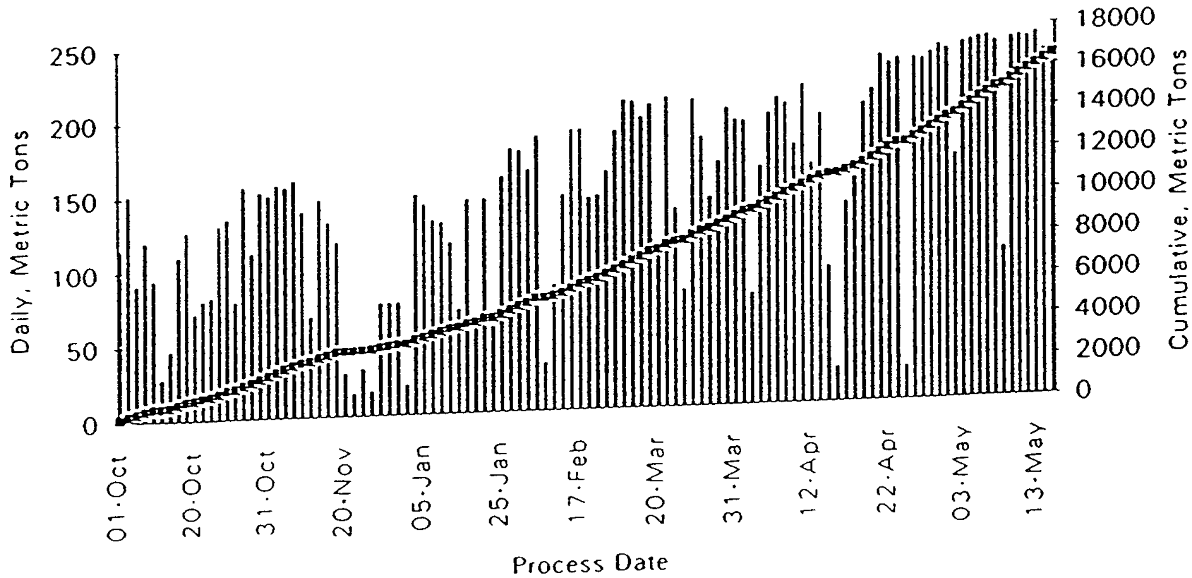

Figure 3-9. Plant daily and cumulative production.

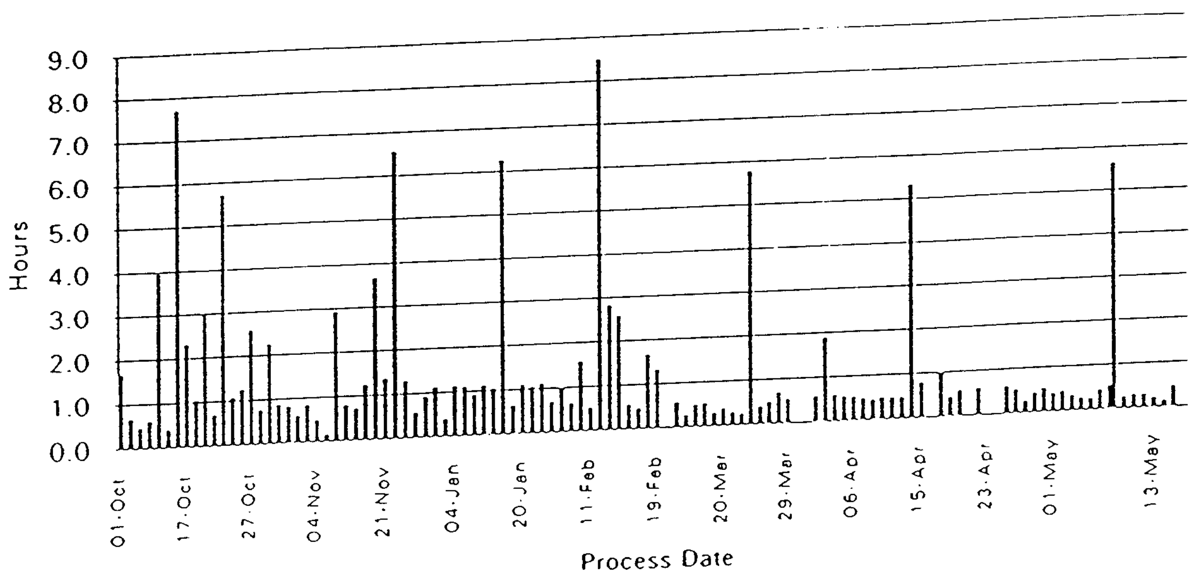

Figure 3-10. Unit 1 hours to startup.

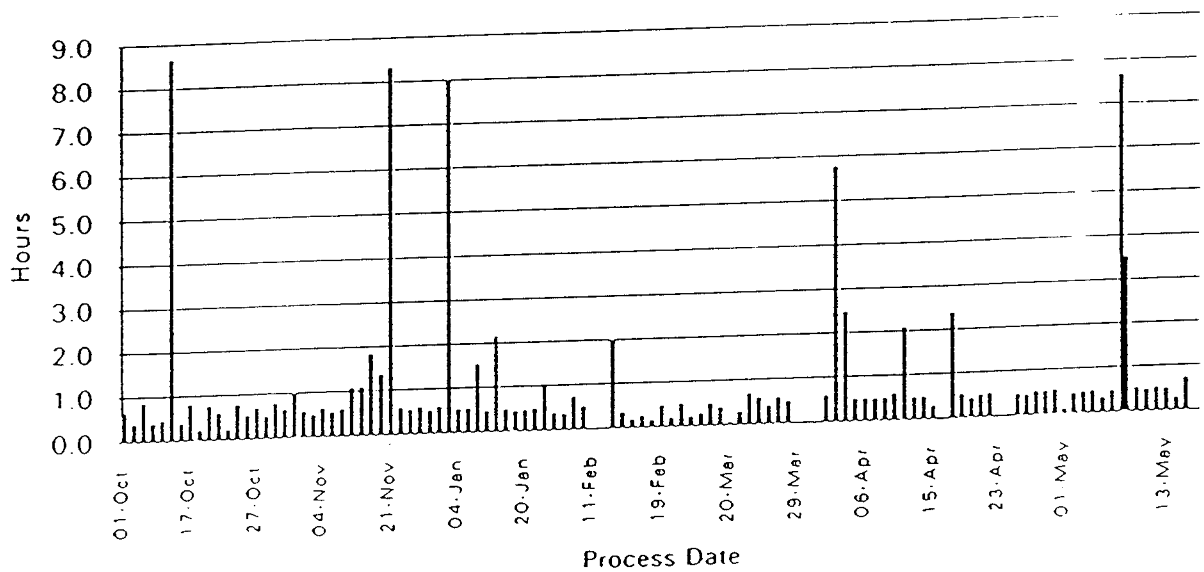

Figure 3-11. Unit 1 hours to shutdown.

respectively; and Figures 3-12 and 3-13, Unit 2 Hours to Startup and Shutdown, respectively, show the time used to start and end soil processing operations for each Option Year 2 process day.

As in previous reporting periods, startup and shutdown times were affected by the need to perform preventive maintenance, as well as by outages due to lack of island electrical power, mechanical failure of plant components, or scheduled plant modifications. However, as displayed in Figure 3-9, production and time utilization showed a generally increasing trend during the period. As shown, production was significantly greater for the second half of the period than for the first half. TMA effected this sustained daily production increase by effectively implementing DNA-approved plant improvements (see Section 2, OPTION YEAR 2 PLANT MODIFICATIONS), staggering work shifts to start the work day earlier and work continuously through the lunch period, and successfully applying experience gained during the previous operating periods.

Figure 3-14, Weekly Hours of Plant Operation From Spreadsheet Totals, displays the total number of hours of plant operation for all operating sorters on a weekly basis beginning with the week of 20 February, 1993. Figure 3-15, Plant Production per Total Weekly Work Hours, shows plant processing hours as a percent of total hours worked during the week, also starting with the week of 20 February, 1993. This starting week was chosen as representing the beginning of full plant production. As shown in these two figures, TMA exceeded DNA's proposed production quota of less than 40% down time (equivalent to approximately 82.8 sorter processing hours per week or 60% of total available hours) for all weeks except for the week of 17 April, based on 11.5 work hours per day over a 6-day week. As noted, loss of production for the week of 17 April was due to a 25-hour power outage during that week.

3.4 MASS MEASUREMENTS.

The mass of feed material processed through the soil cleanup plant is monitored using two methods. The first method is by calculation using the JACC computer software code. The JACC-calculated mass is based on soil density as entered by the plant operator and the length of time the plant is operated. TMA summarized this data using the DNA-provided Symphony spreadsheet (see Section 3.1, PLANT PRODUCTION DURING OPTION YEAR 2).

Data are summarized daily. Results were transmitted to DNA on a weekly basis as attachments to Weekly Reports, and are included in this report in APPENDIX A, JA SOIL CLEANUP PLANT LOG SUMMARIES. Processed mass is also directly measured by calibrated conveyor belt scales. Figure 3-16, Weekly Plant Production From Sorter Belt Scale, presents the belt scale data summarized and plotted on a weekly basis. Figure 3-17, Weekly Production From Spreadsheet Totals, similarly presents the spreadsheet data summarized and plotted on a weekly basis. As

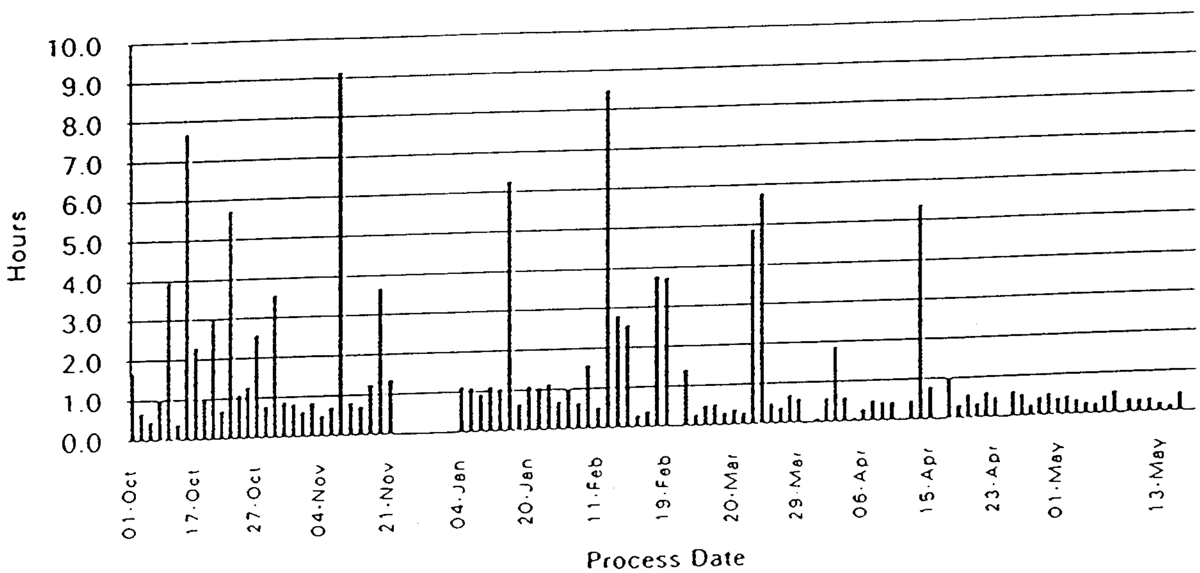

Figure 3-12. Unit 2 hours to startup.

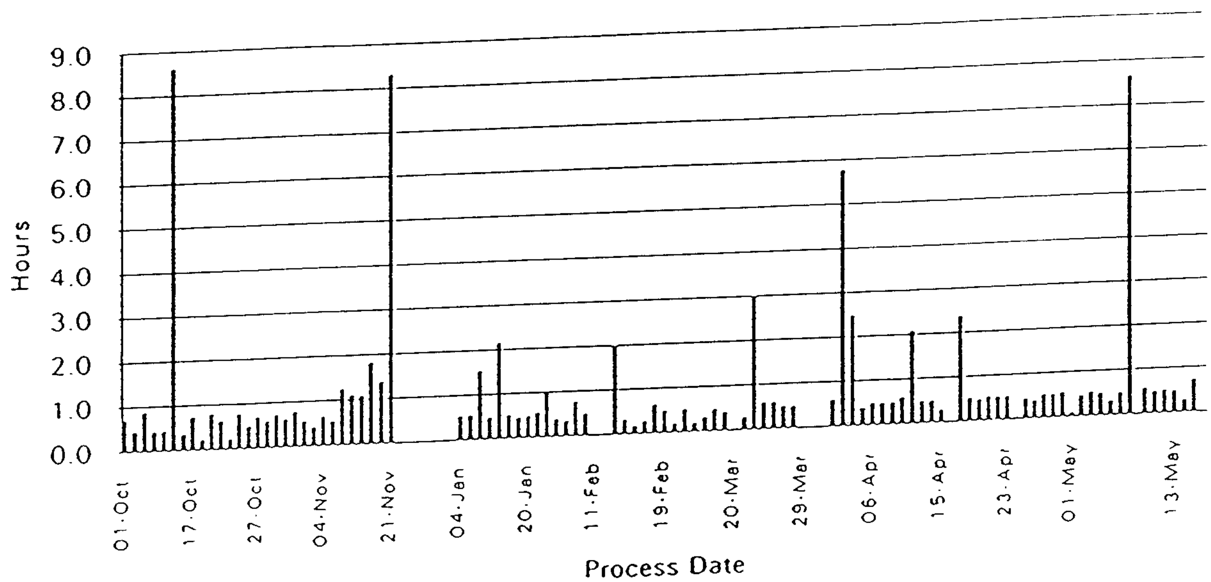

Figure 3-13. Unit 2 hours to shutdown.

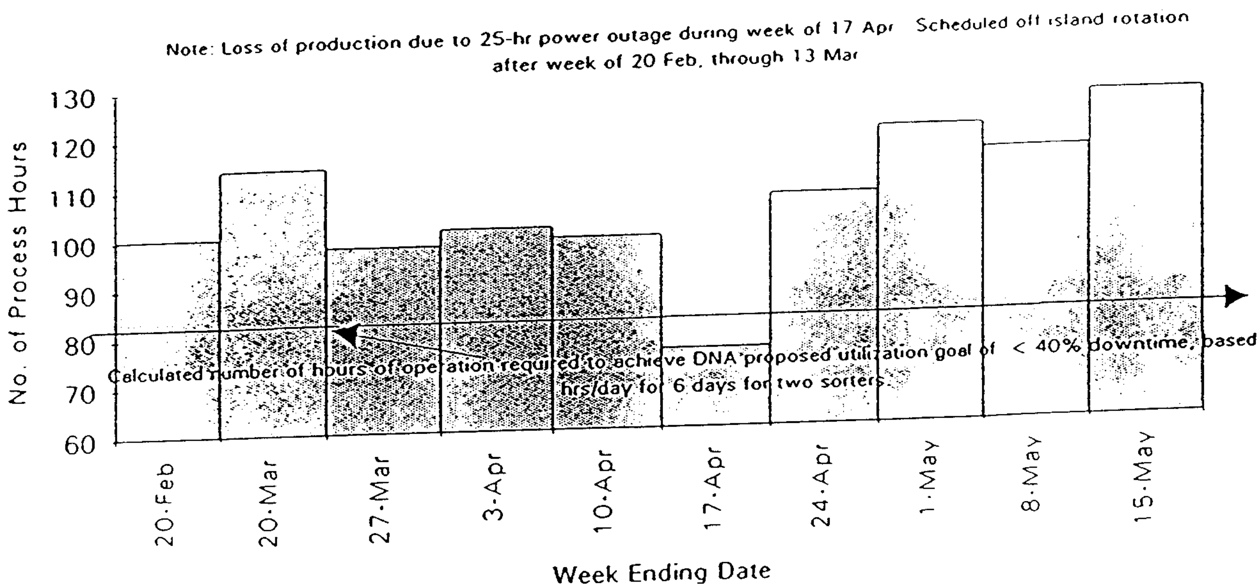

Figure 3-14. Weekly hours of plant operation from spreadsheet totals.

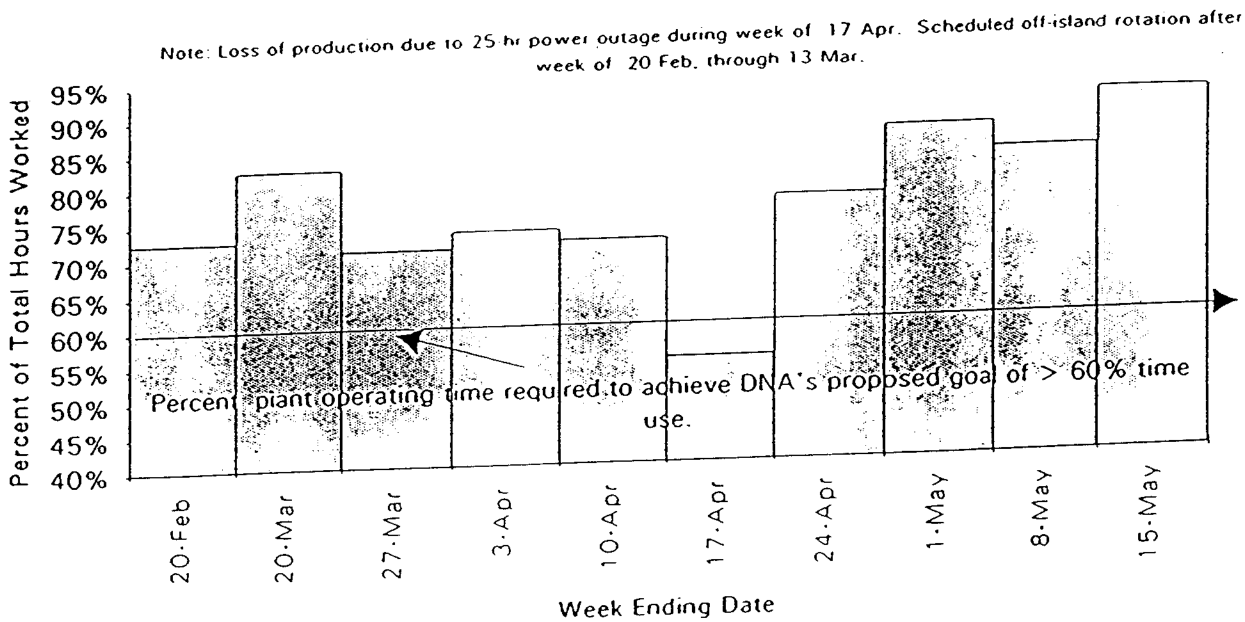

Figure 3-15. Plant production per total weekly work hours.

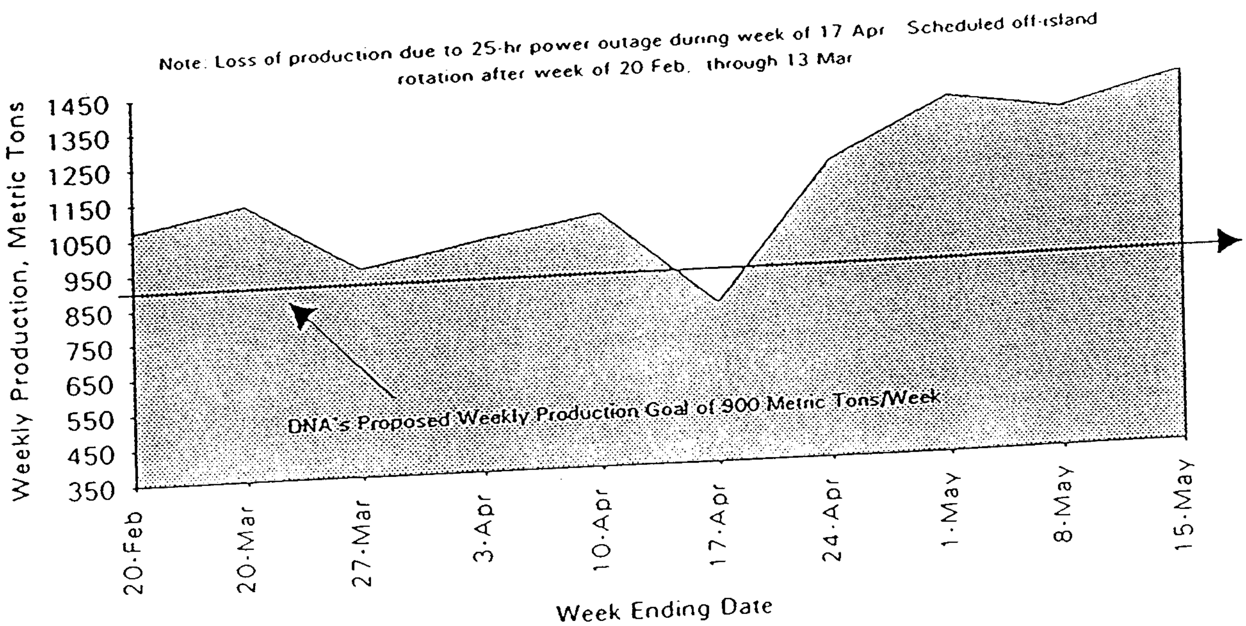

Figure 3-16. Weekly plant production from sorter belt scale.

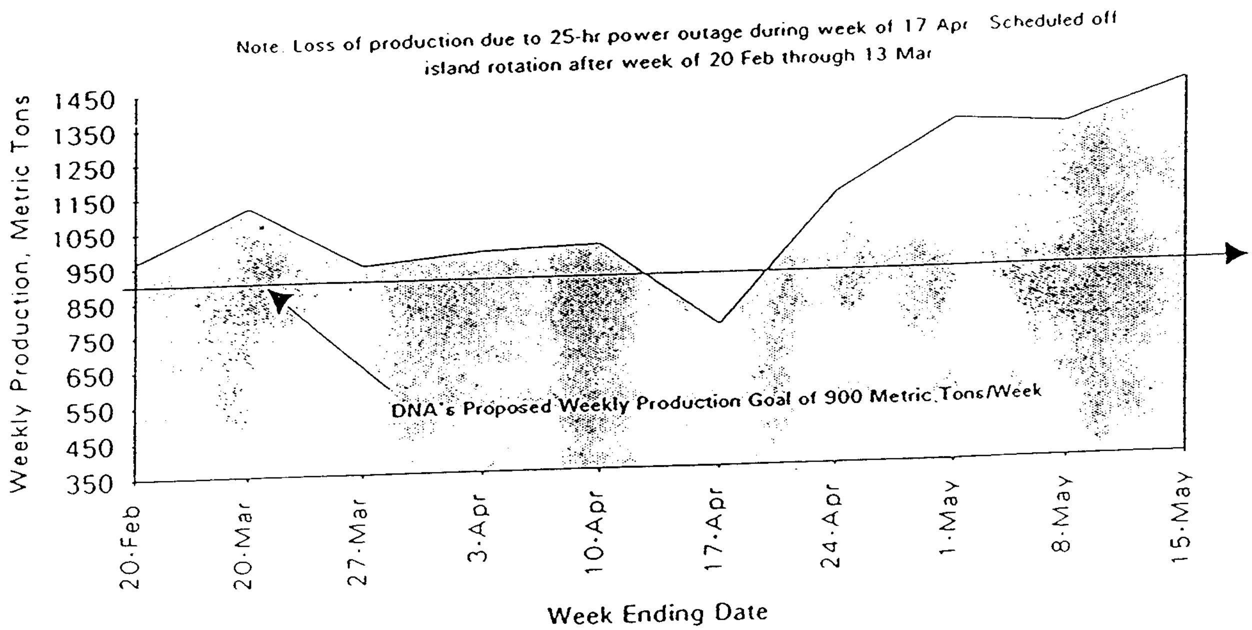

Figure 3-17. Weekly production from spreadsheet totals.

displayed, TMA exceeded DNA's proposed production goal of 900 metric tons per week for all weeks starting with the week ending 20 February onward, with the exception of the week ending 17 April. During that week, production was limited by a 25-hour electrical power outage. A comparison of weekly plant production between spreadsheet totals and belt scale total is displayed in Figure 3-18, Weekly Plant Production Comparison. For the periods tracked, the weekly production from spreadsheet totals averaged 1092 metric tons per week. Similarly, the weekly plant production from the sorter feed belt scale averaged 1131 metric tons per week. Overall, the spreadsheet totals were slightly lower, and were calculated to be 96.55% of the belt scale totals. Spreadsheet and belt scale totals agreed within 5% overall.

A major factor in the difference between spreadsheet and belt scale product mass is the change in surface density of the feed material on the moving conveyor belt. Accordingly, DNA directed that TMA develop a means to monitor surface density (see Section 2, PLANT MODIFICATIONS) to provide confirmatory data in support of the daily operator-entered density of the JACC computer software. Density measurements are presented in tabularized form in APPENDIX F, DENSITY MEASUREMENTS. Results are charted in Figure 3-19, Soil Density Measurements. Surface density ranged from approximately 1.07 to 1.56. Figures 3-20 through 3-31 display the daily sorter feed belt scale percent difference from spreadsheet totals and the belt scale daily readings versus spreadsheet totals on a weekly basis. The figures present data from the weeks ending 5 April, when the database was started, through 15 May, the last day of soil processing. TMA previously transmitted these figures to DNA as attachments to the weekly reports with, the exception of the final two week period. The figures are included in this report for completeness.

3.5 RADIOLOGICAL RESULTS OF SOIL PROCESSING.

3.5.1 Computer Records.

Records of detection and sorter assay of "hot" particles are generated and stored at the time that each particle is first identified by the detector and microprocessor circuits in the detector box. Record logs of evaluations of feed material for

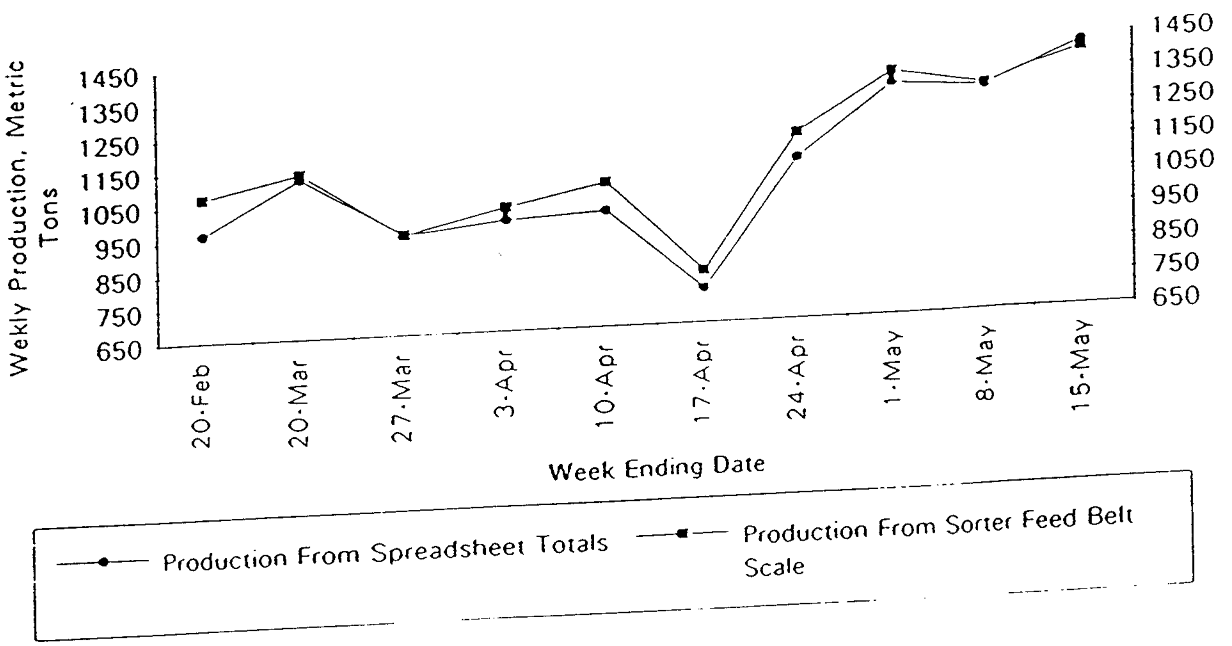

Figure 3-18. Weekly plant production comparison.

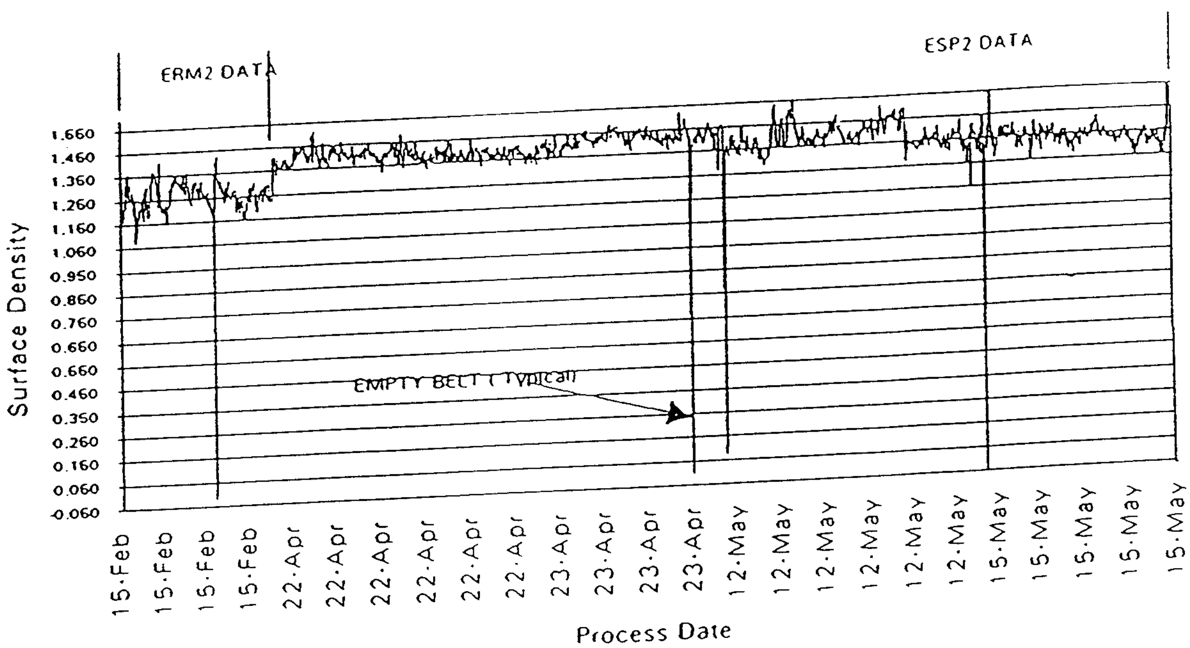

Figure 3-19. Soil density measurements.

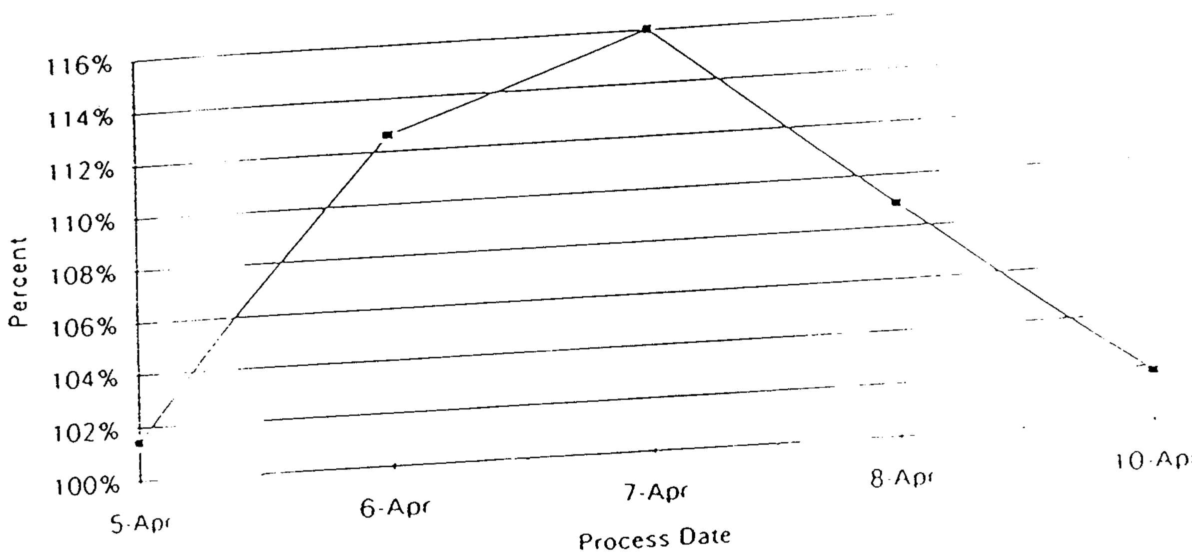

Figure 3-20. Daily sorter feed belt scale percent difference from spreadsheet totals, week of 10 April, 1993.

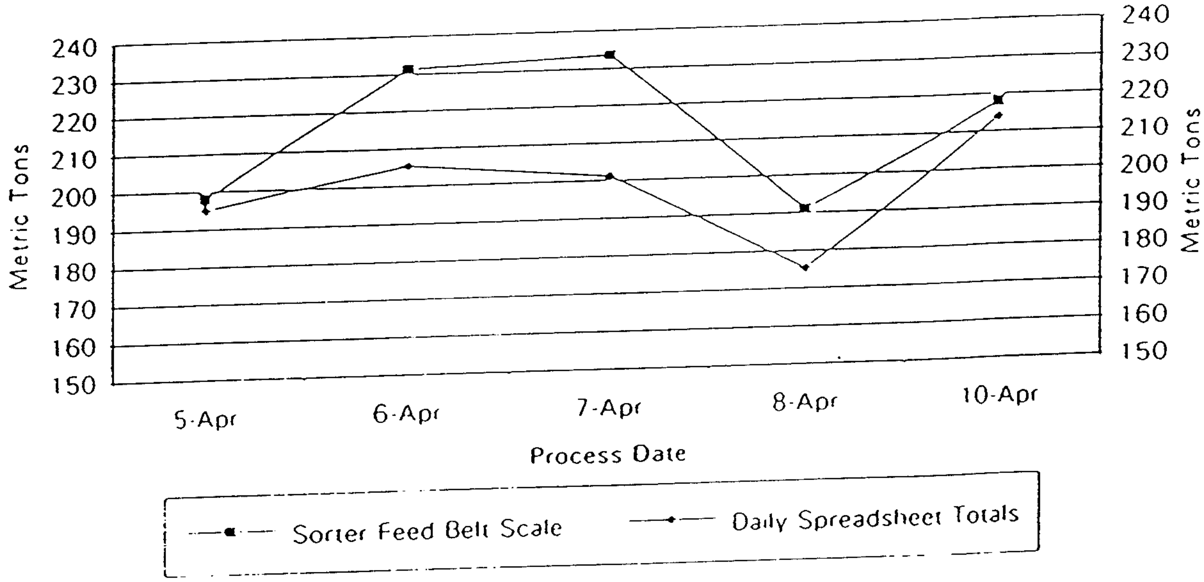

Figure 3-21. Belt scale daily readings vs spreadsheet totals, week ending 10 April, 1993.

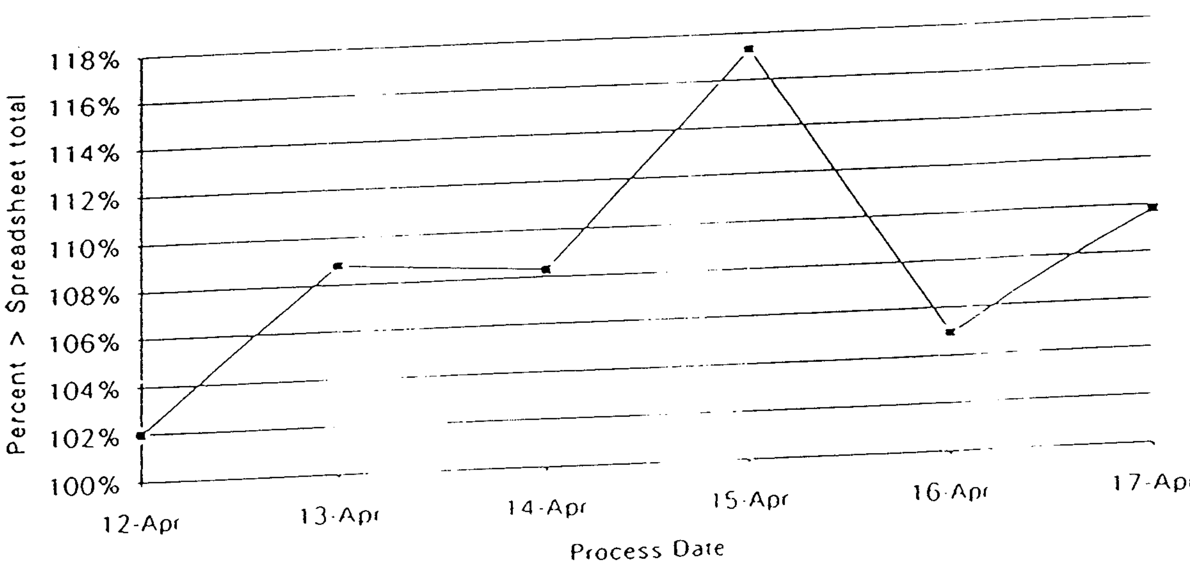

Figure 3-22. Sorter feed belt scale percent difference from spreadsheet totals, week of 17 April, 1993.

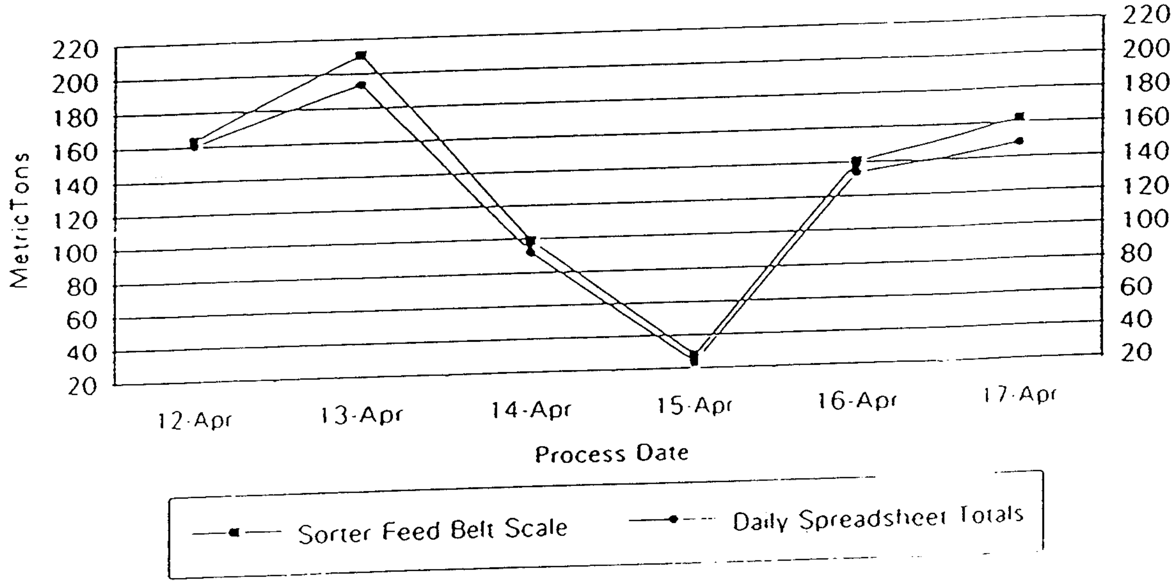

Figure 3-23. Belt scale daily readings vs spreadsheet totals, week ending 17 April, 1993.

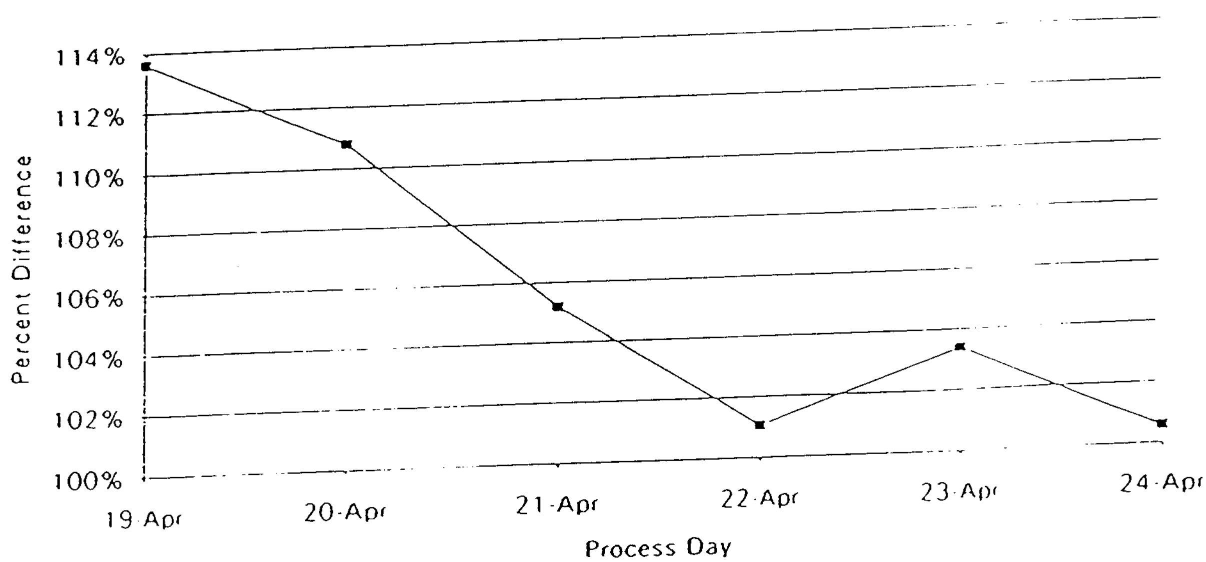

Figure 3-24. Sorter feed belt scale percent difference from spreadsheet totals, week of 24 April, 1993.

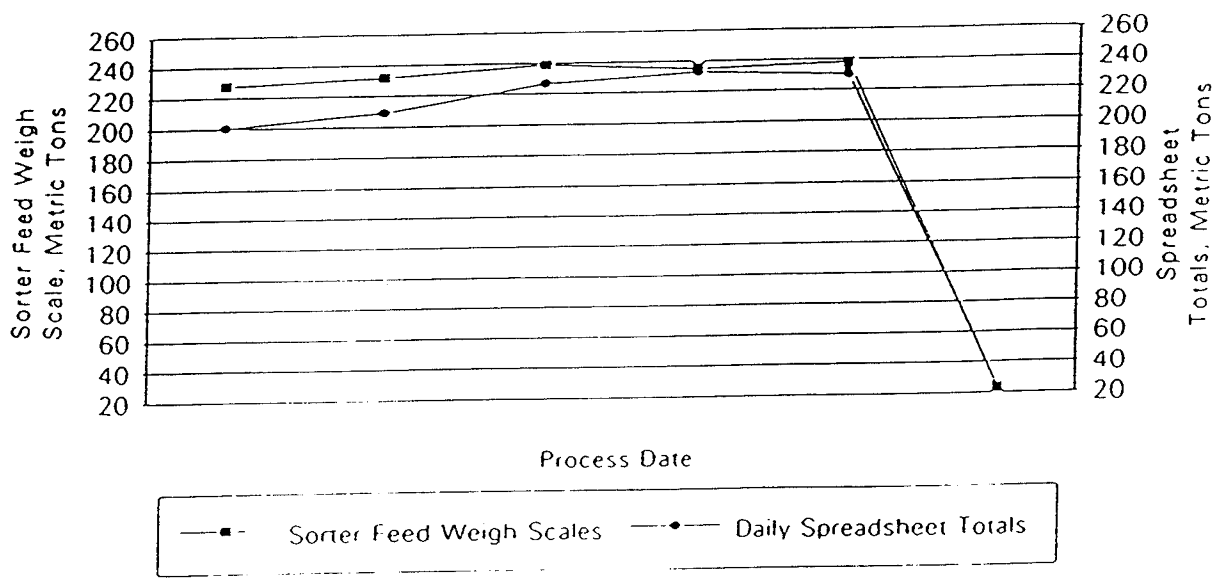

Figure 3-25. Belt scale daily readings vs spreadsheet totals, week ending 24 April, 1993.

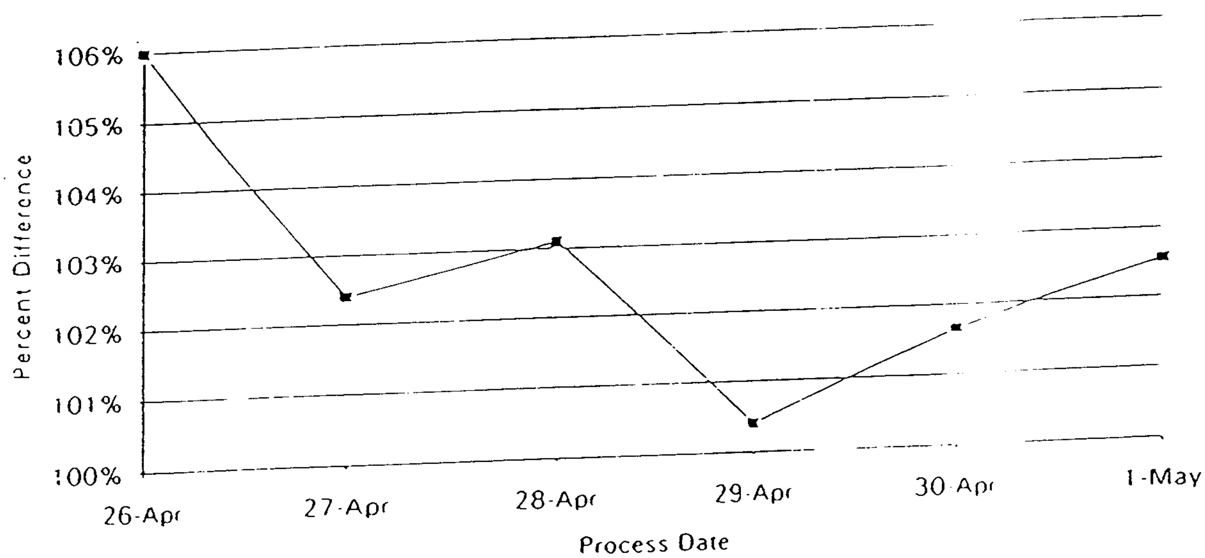

Figure 3-26. Sorter feed belt scale percent difference from spreadsheet totals, week of 1 May, 1993.

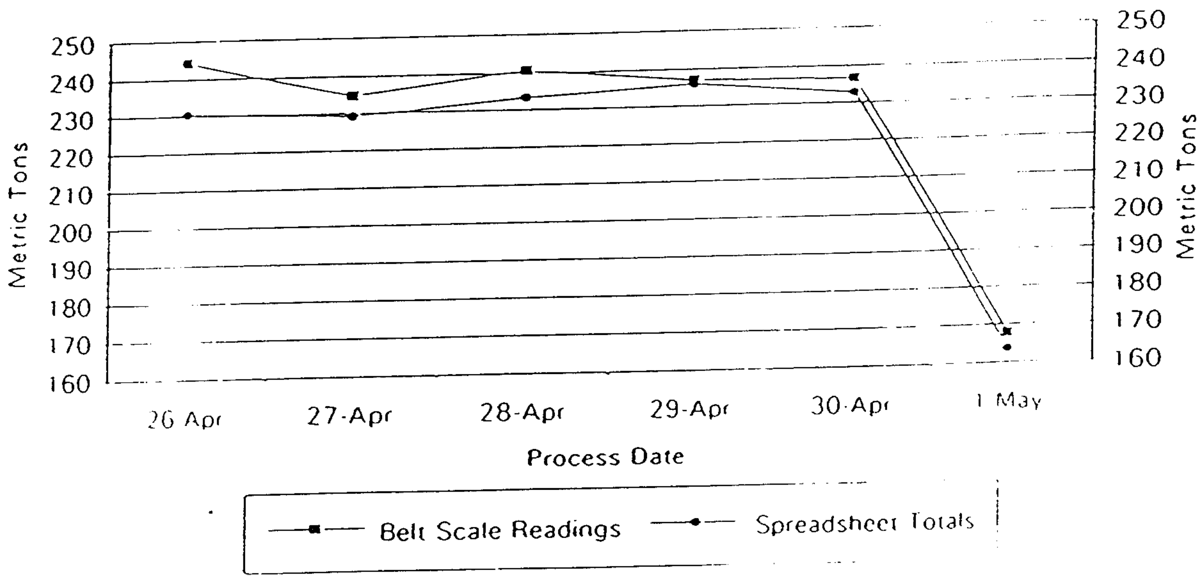

Figure 3-27. Sorter feed belt scale daily readings vs spreadsheet totals, week ending 1 May 1993.

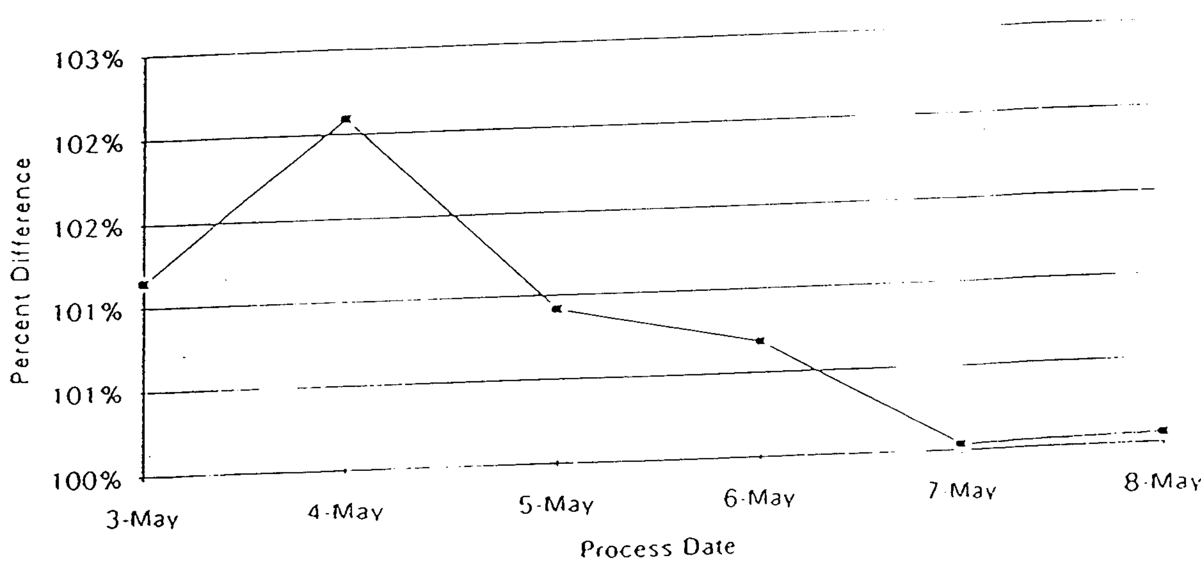

Figure 3-28. Sorter feed belt scale percent difference from spreadsheet totals, week of 8 May, 1993.

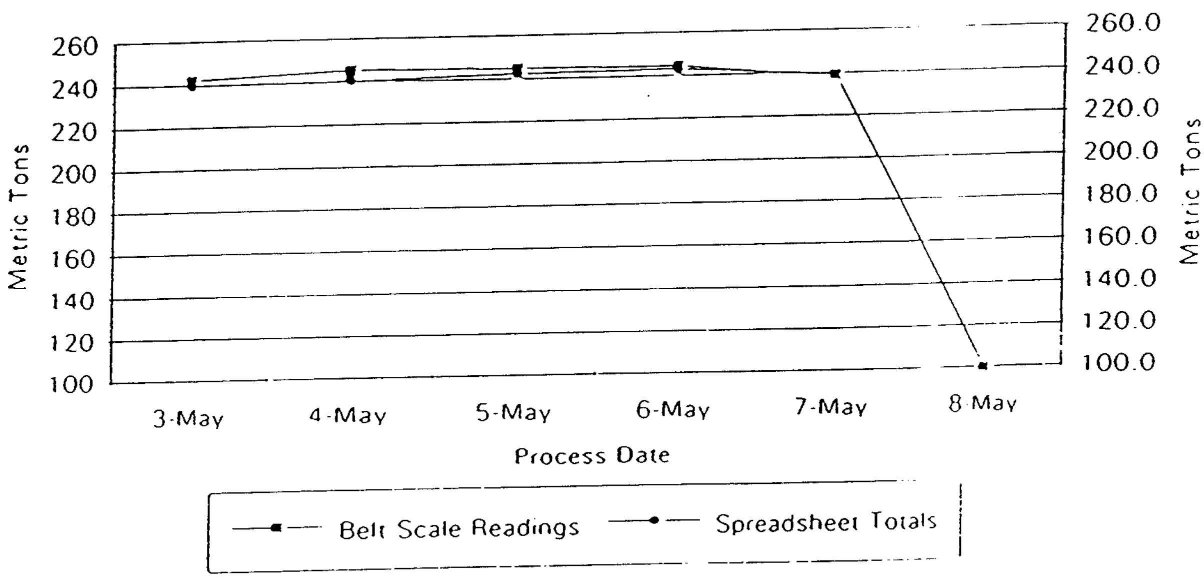

Figure 3-29. Sorter feed belt scale daily readings vs spreadsheet totals, week ending 8 May 1993.

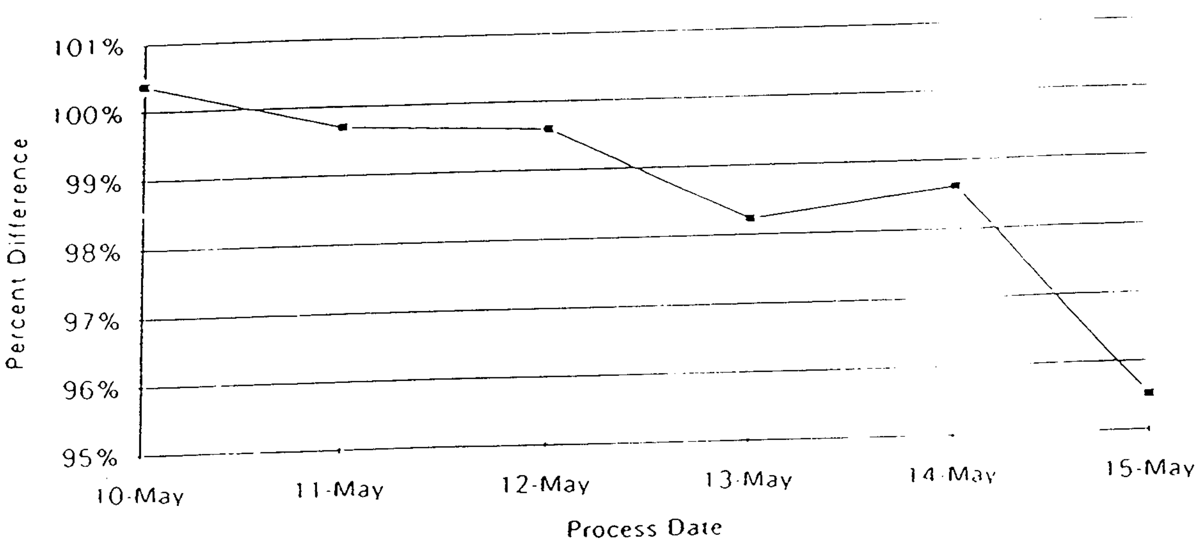

Figure 3-30. Sorter feed belt scale percent difference from spreadsheet totals, week of 15 May, 1993.

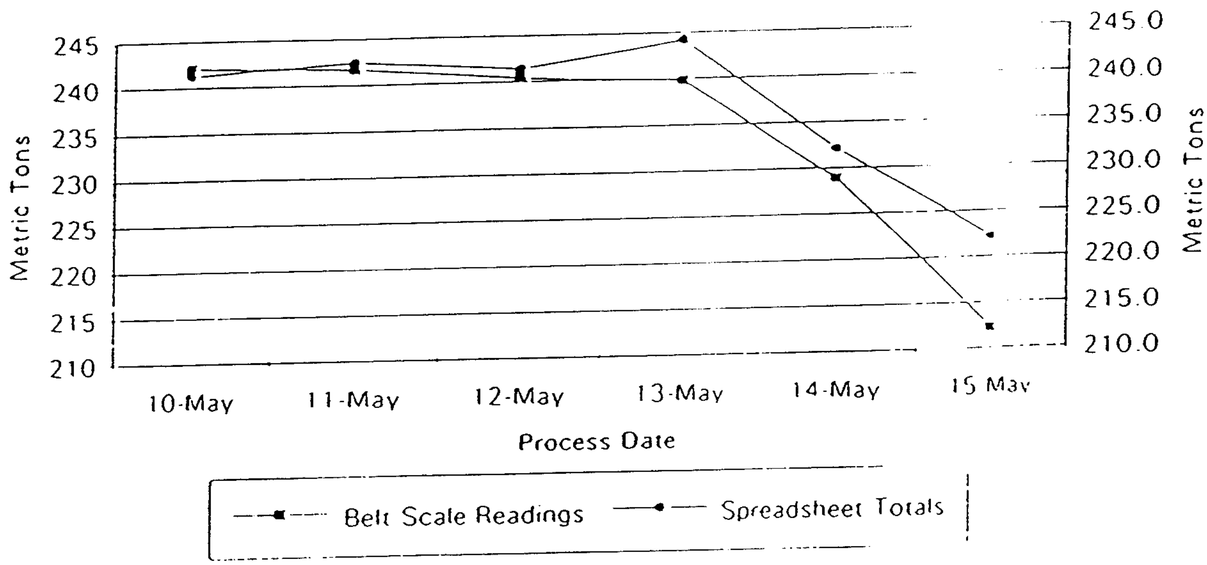

Figure 3-31. Sorter feed belt scale daily readings vs spreadsheet totals, week ending 15 May 1993.

distributed radioactivity greater than 500 Bq/kg are generated every 20 seconds during soil processing (TMA, 1993). Figure 3-32, Combined Daily Number of Records, Units 1 and 2, displays the daily number of computer records logged by the JACC software for both operating soil sorting systems on a daily basis. Figure 3-33, Daily and Cumulative Number of Sorter Records, plots the cumulative number of computer records during Option Year 2 against the number of records generated by all operating units on a daily basis. Over 450,00 individual records of soil sorting activity were recorded by the control room personal computer during the period. The maximum number of records generated by both units together was over 10,000 records in any one day.

3.5.2 Recovered Radioactivity.

Figure 3-34, Daily Recovered Radioactivity, Units 1 and 2 Combined, displays the activity in thousands of Becquerels (kiloBecquerels) removed from contaminated feed material by the operating Segmented Gate Systems on a daily basis. Figure 3-35, Cumulative Recovered Radioactivity, plots the cumulative radioactivity in kiloBecquerels (kBq) removed on a daily basis. Figure 3-36, Daily and Cumulative Recovered Radioactivity, combines the data from the preceding two figures. Daily values are shown in columns. Total radioactivity removed from contaminated feed material during the period exceeded 1,400,000 kBq, or the equivalent of approximately 0.6 grams of ^{239}Plutonium.

3.5.3 Processed Mass and Recovered Radioactivity.

Figure 3-37, Cumulative Processed Mass and Recovered Radioactivity, plots the amount of mass processed on a cumulative daily basis in metric tons (shown in columns) with the amount of cumulative radioactivity recovered in kiloBecquerels. Figure 3-38, Daily Processed Mass and Recovered Radioactivity, shows the mass of processed feed material in metric tons (shown in columns) plotted with the radioactivity in kiloBecquerels removed on a daily basis. Figure 3-39, Daily Percent Weight Reduction and Recovered Radioactivity, likewise displays the weight reduction of contaminated feed material as a percent of total material processed (shown in columns) with the daily recovered radioactivity in kiloBecquerels. Figure 3-40, Daily Activity Recovered Per Process Ton, plots the quotient of the number of kiloBecquerels of radioactivity removed from contaminated feed and the number of process tons per day. Results ranged from less than 50 to over 350 kiloBecquerels per process ton per day.

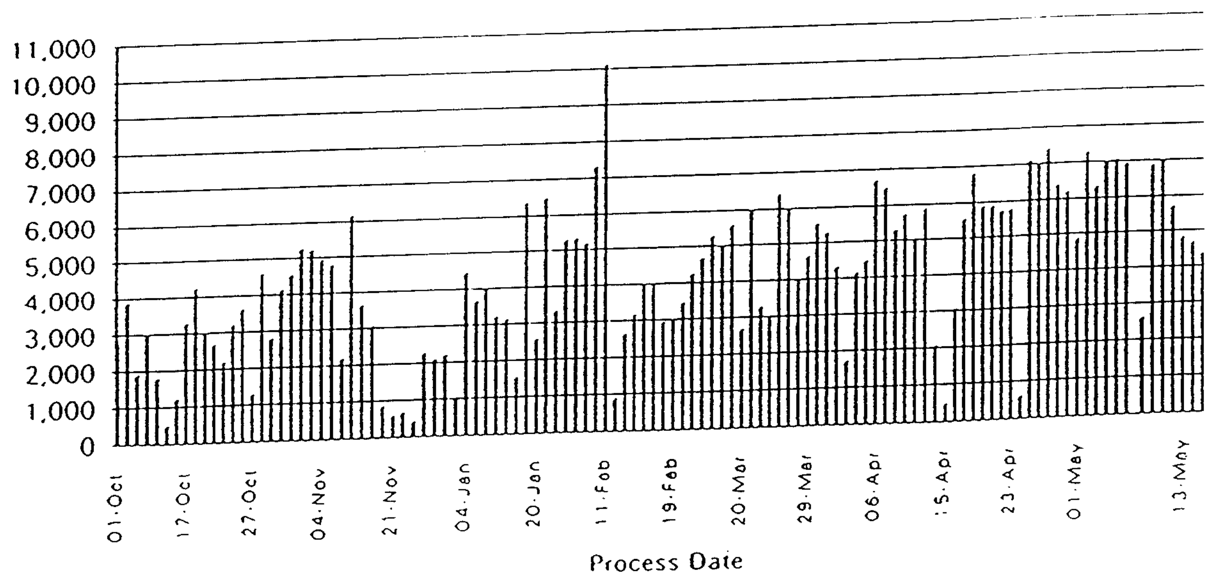

Figure 3-32. Combined daily number of records, units 1 and 2.

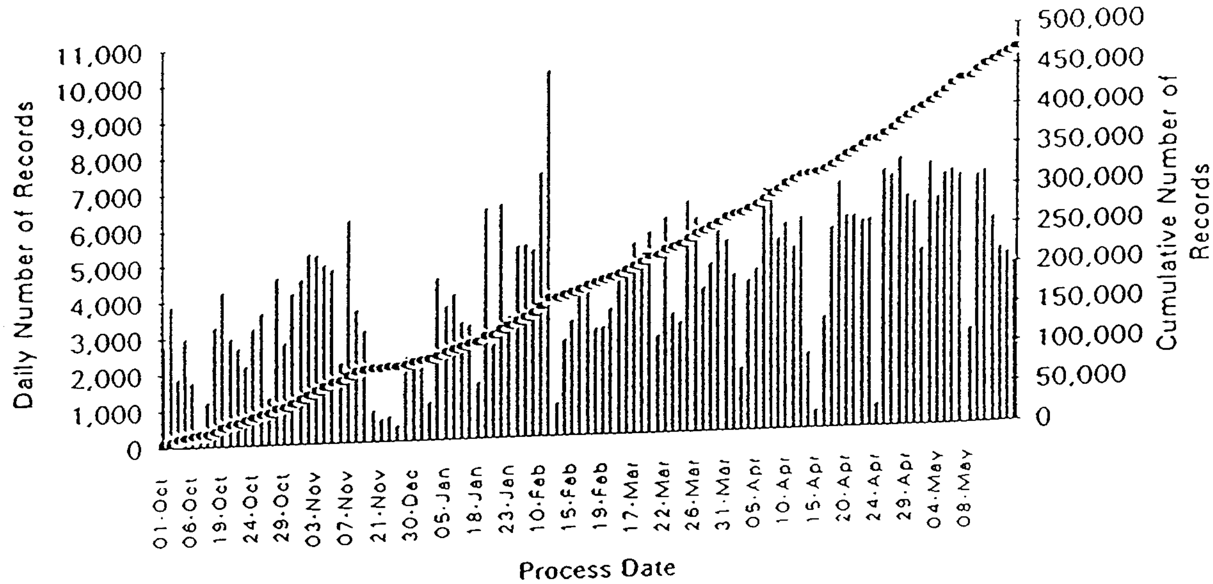

Figure 3-33. Daily and cumulative number of sorter records.

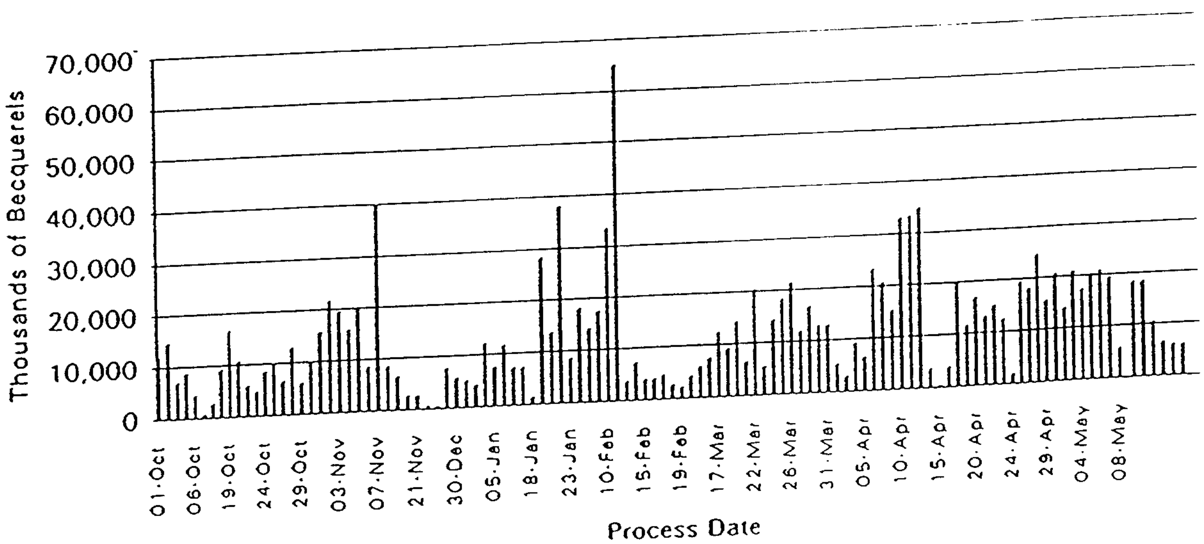

Figure 3-34. Daily recovered radioactivity, units 1 and 2 combined.

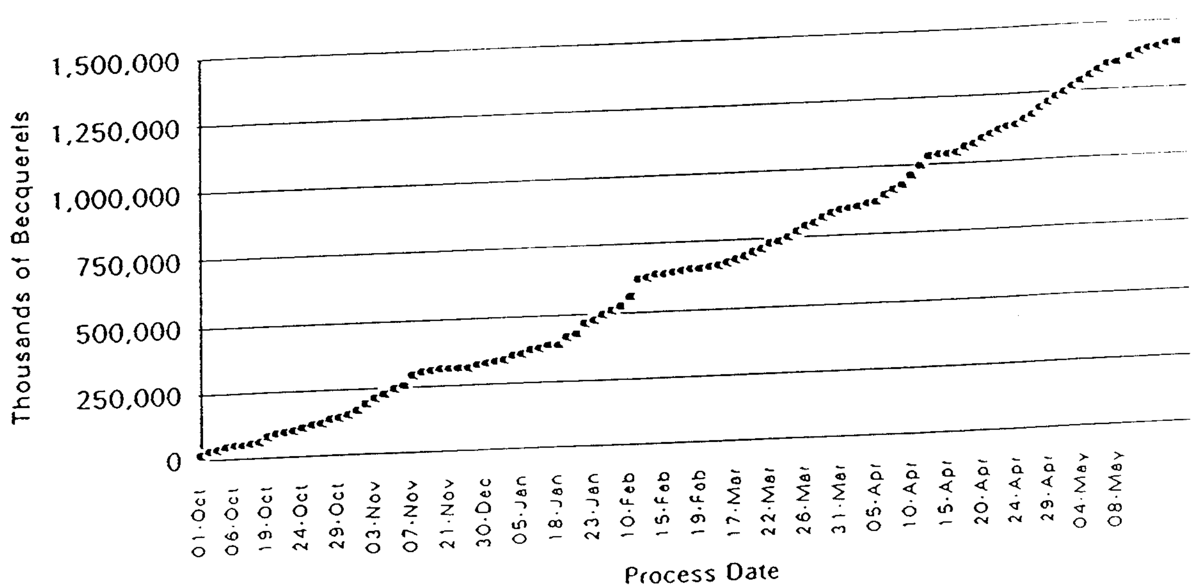

Figure 3-35. Cumulative recovered radioactivity.

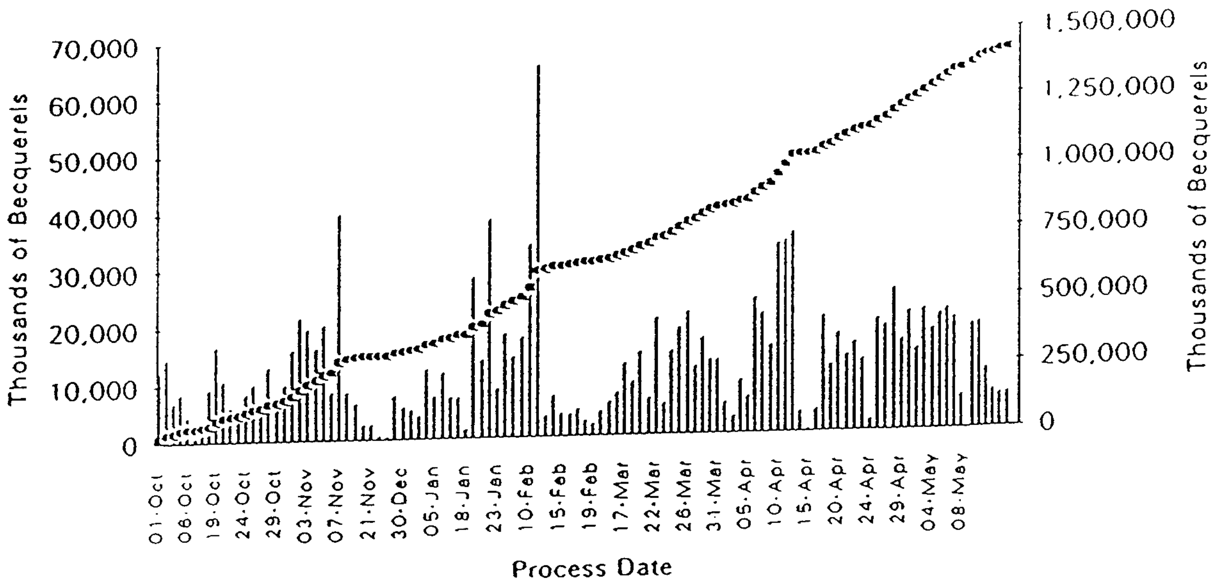

Figure 3-36. Daily and cumulative recovered radioactivity.

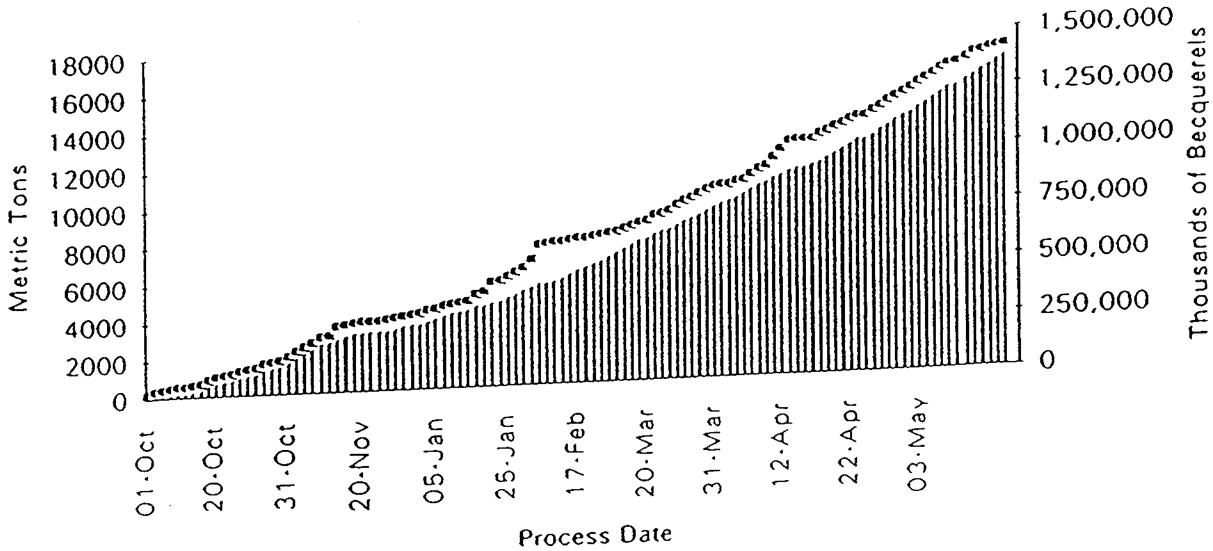

Figure 3-37. Cumulative processed mass and recovered radioactivity.

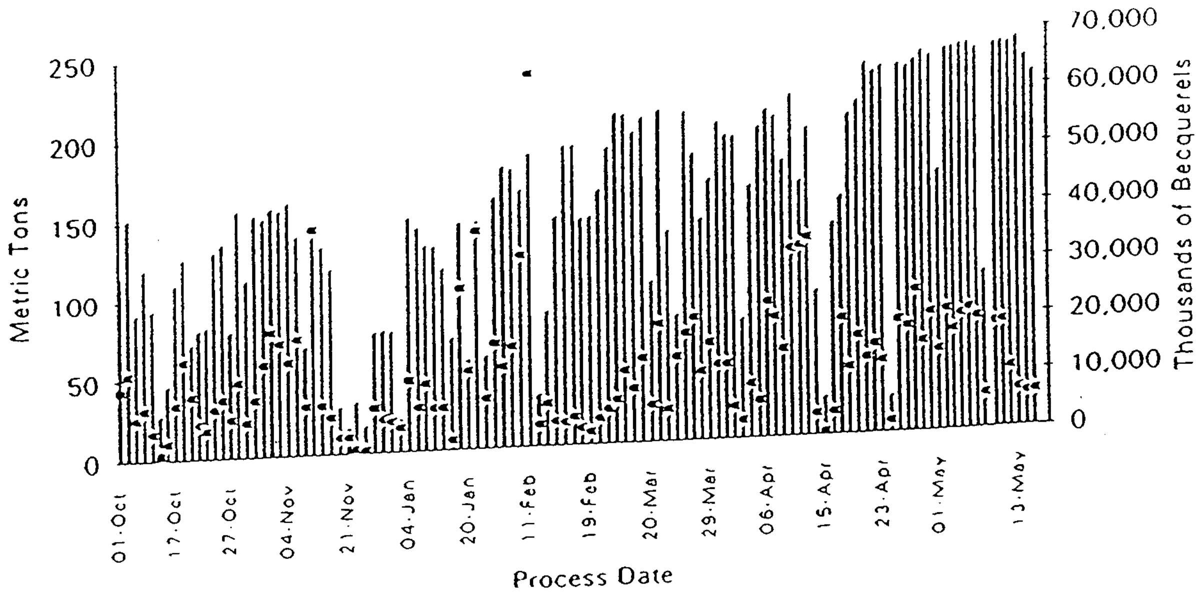

Figure 3-38. Daily processed mass and recovered radioactivity.

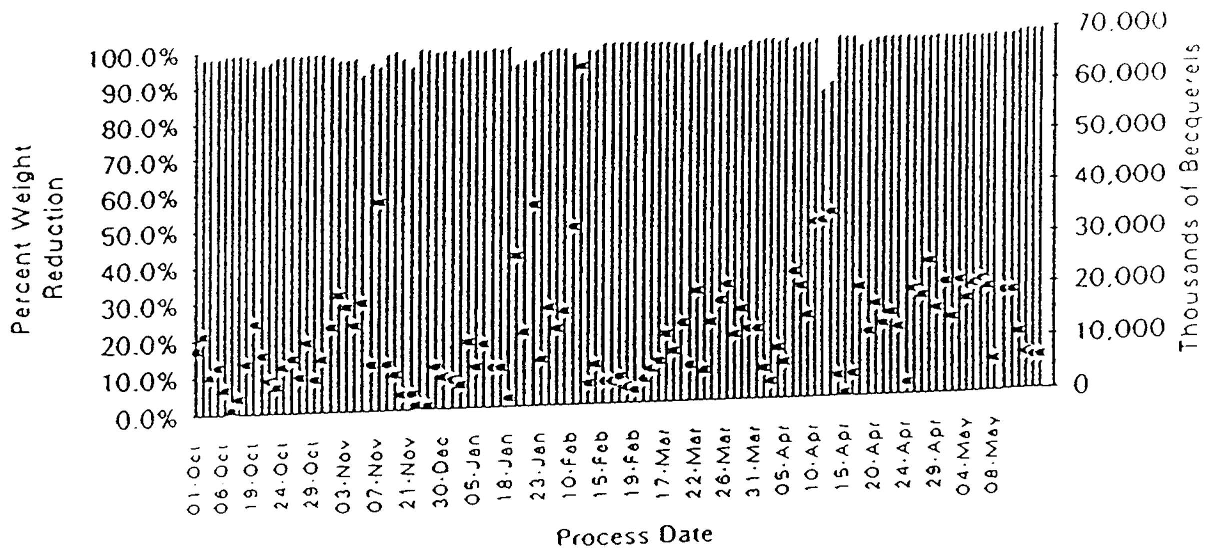

Figure 3-39. Daily percent weight reduction and recovered radioactivity.

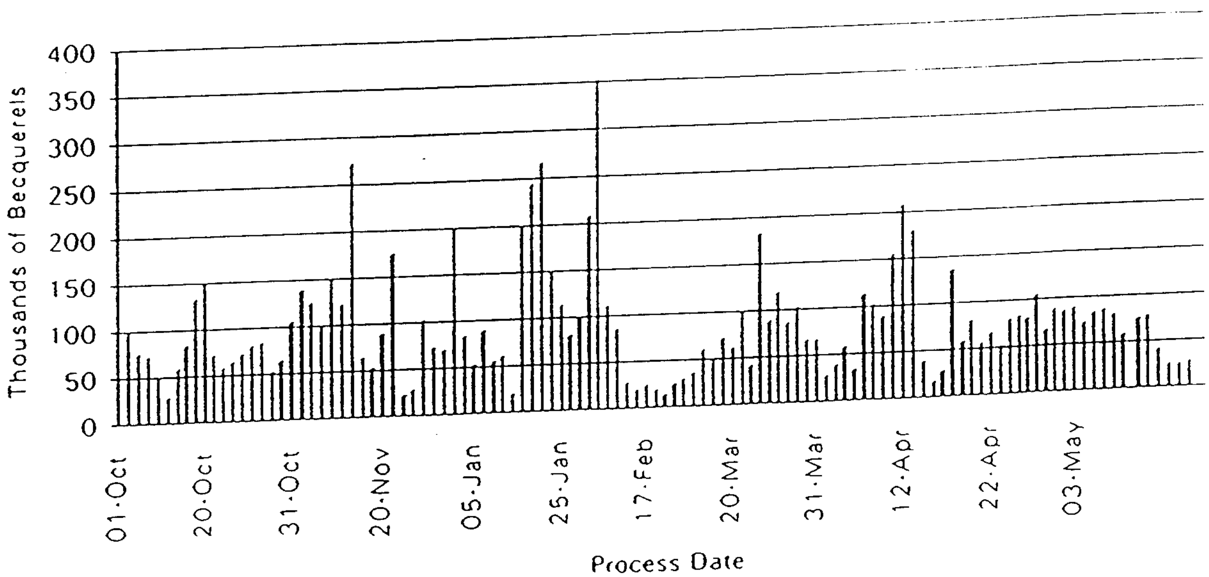

Figure 3-40. Daily activity recovered per process ton.

SECTION 4

QUALITY ASSURANCE

4.1 SOIL CONTAMINATION LIMITS.

As in previous reporting periods, the soil cleanup process must provide assurance that soil released from the JA Plutonium Soil Cleanup Plant as "clean" complies with established DNA cleanup criteria based on EPA guidelines ([3]EPA, 1988). The soil cleanup plant is intended to clean contaminated JA feed soil for release for unrestricted use to less than 500 Becquerels of transuranic alpha activity per kilogram (Bq/kg) of soil averaged over a volume no greater than 0.1 cubic meter. In addition, no radioactive ("hot") particles of greater than 5000 Bq may be present in cleaned soil.

Soil designated as radioactive waste must be properly characterized and certifiable for expected transport and disposal in accordance with established disposal site Waste Acceptance Criteria (WAC).

4.2 QUALITY CONTROL SAMPLING AND SURVEYS.

TMA routinely performed quality control (QC) sampling and hand-held instrument surveys on the "clean" soil pile to verify that the sorting system process was operating according to design specifications. TMA's second annual report to DNA (TMA, 1993) describes this process in detail.

During Option Year 2, TMA staff continued to take QC samples approximately once per hour. The samples were counted for five minutes using a calibrated EIC Model MS-2 miniscaler coupled to a Bicron shielded FIDLER in the on-site TMA count laboratory. TMA's QA/QC Technician managed the sampling program. Prior to counting the QC sample, the FIDLER chamber was counted empty to establish the daily background count, and a laboratory "blank" of clean coral soil weighing 113.6 grams is counted as a reference to the background count. The source standard, which also weighs 113.6 grams, was counted to calculate a daily efficiency and to use as a comparison to the results of the QC sample counts (net of background). The daily calculated efficiency was plotted on a control chart. All control charts and counting instrument calibration forms are maintained as Quality assurance (QA) records.

QC samples with measured activity of less than the daily source standard count were reported as "< Standard," and samples with higher counts than the daily source standard were reported as "> Standard" on the QA Sample Collection Record form. Data from the QA Sample Collection Record form was transferred to computer disk for spreadsheet reporting. Shielded FIDLER analysis was

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[3] Guidance on Dose Limits for Persons Exposed to Transuranium Elements in the General Environment, U.S. Environmental Protection Agency, EPA 520/4-77-016, 1977, Revised, 1988.

performed on samples taken on all soil processing days during the period. Results are provided in APPENDIX E, QC SOIL ANALYSIS BY SHIELDED FIDLER.

Five QC samples drawn from the "clean" soil pile were initially found to contain radioactivity above the reference source activity. These samples were recounted to verify activity, and management was notified. The sample was then divided until in each case a single radioactive particle was identified.

Figure 4-1, Quality Control Soil Sample Results, displays results of QC sampling of the "clean" soil pile during the Option Year 2 period. The five QC samples initially determined to contain radioactivity greater than the source standard are identified by sample number near the plotted analytical value. Data for samples numbered QA 517 through QA 530 was not found in the file, and was omitted from the chart. However, all of these samples were analyzed by TMA staff in the on-site laboratory, and were found to contain levels of radioactivity less than the source standard. Figure 4-2, QC Samples > Source Standard, shows the initial analytical result for the five samples identified as containing activity greater than the source standard. After division of the sample to isolate the radioactive component, it was verified that the particles so identified contained activity below the 5000 Becquerel criteria. Figure 4-3, Quality Control Soil Sample Results, Replotted, shows the QC sampling results replotted with data from the five samples greater than the source standard omitted. Radioactivity in these QC samples ranged from approximately -200 Bq/kg to +450 Bq/kg. All of these samples were below the DNA radioactivity limit of 500 Bq/kg.

Surveys were also performed hourly during soil processing directly on the surface of the "clean" soil pile using a calibrated ESP-2 with a FIDLER probe. The ESP-2 is set to alarm at 500 Becquerels gross count in 30 seconds. Tabularized survey results are included in APPENDIX D, ESP CLEAN PILE SURVEY RESULTS, and displayed in Figure 4-4, ESP/FIDLER Survey Data - Clean Soil Pile. As shown, one alarm occurred on April 27, 1993 at 1308 hours. Investigation showed that the alarm was caused by a "hot" particle of less than 5000 Becquerels.

4.3 DECOMMISSIONING PLAN.

At DNA's direction, TMA developed the plant Decommissioning Plan (see APPENDIX B, JA PLUTONIUM SOIL CLEANUP PLANT DECOMMISSIONING PLAN) to establish decommissioning guidelines in accordance with salient regulatory requirements. In this plan, TMA effectively consolidated simple, practical methods, based upon the release criteria of the proposed ANSI Standard, for use on JA.

It is expected that TMA's trained individual staff members will be able to effectively apply the required industrial and/or radiological techniques necessary for removal, preparation for disposition, and radiological survey of plant components,

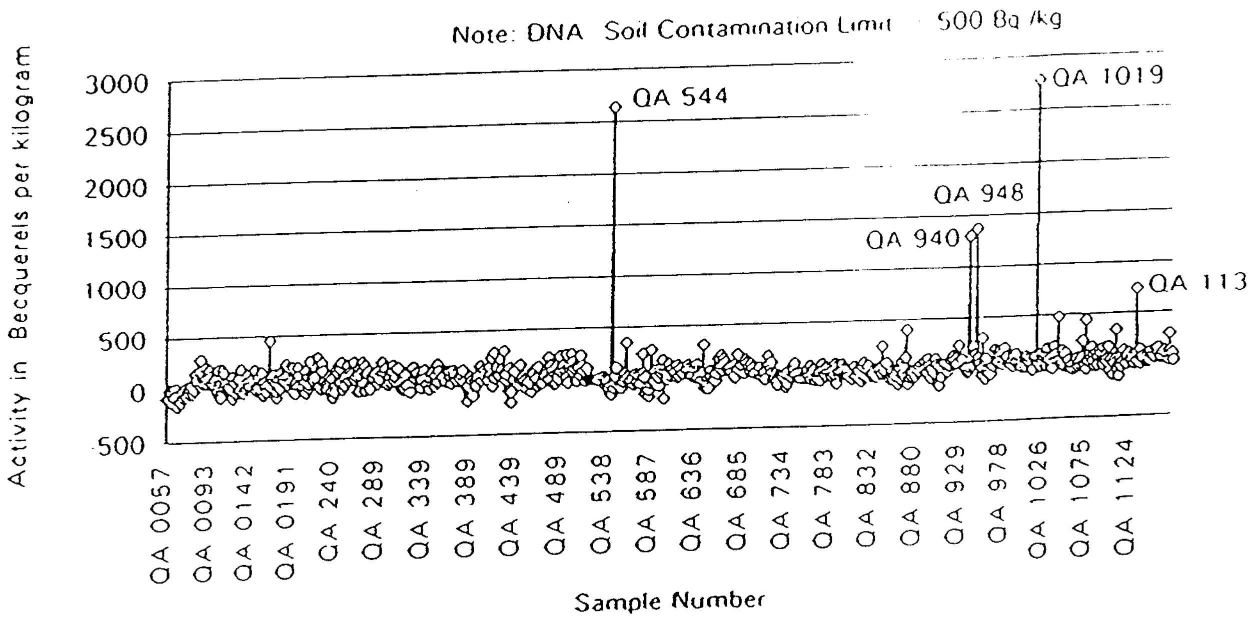

Figure 4-1. Quality Control soil sample results.

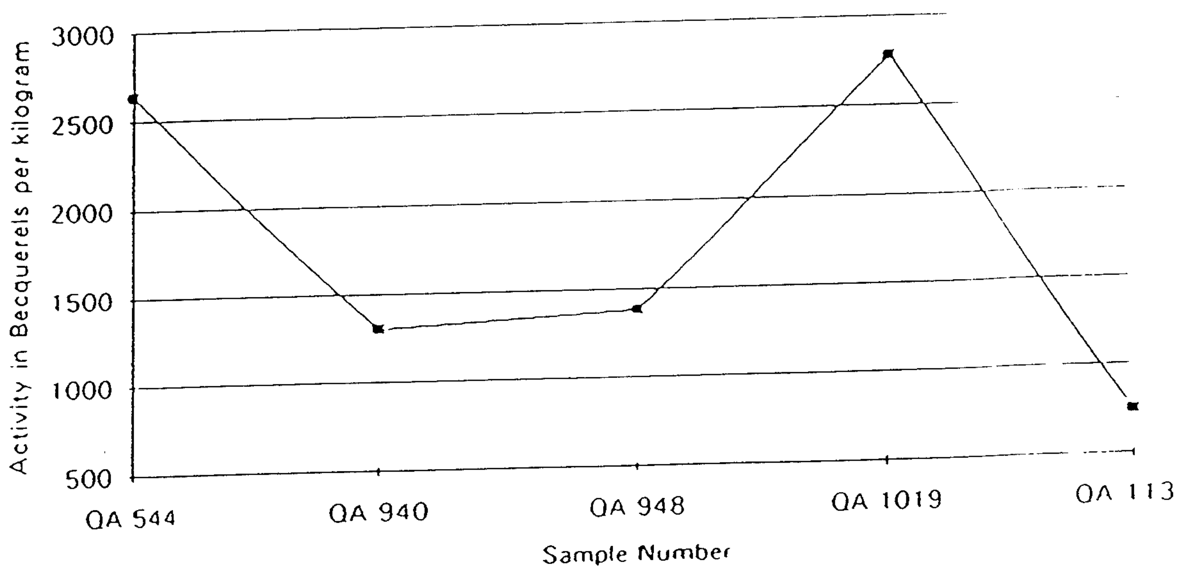

Figure 4-2. QC samples > source standard.

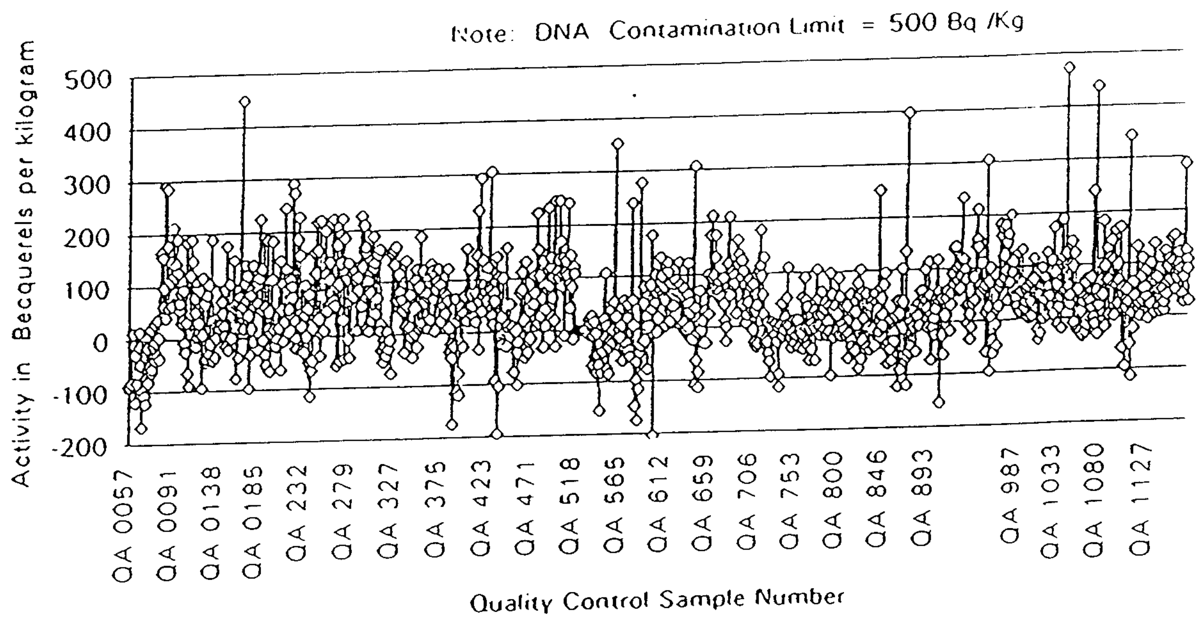

Figure 4-3. Quality Control soil sample results, replotted.

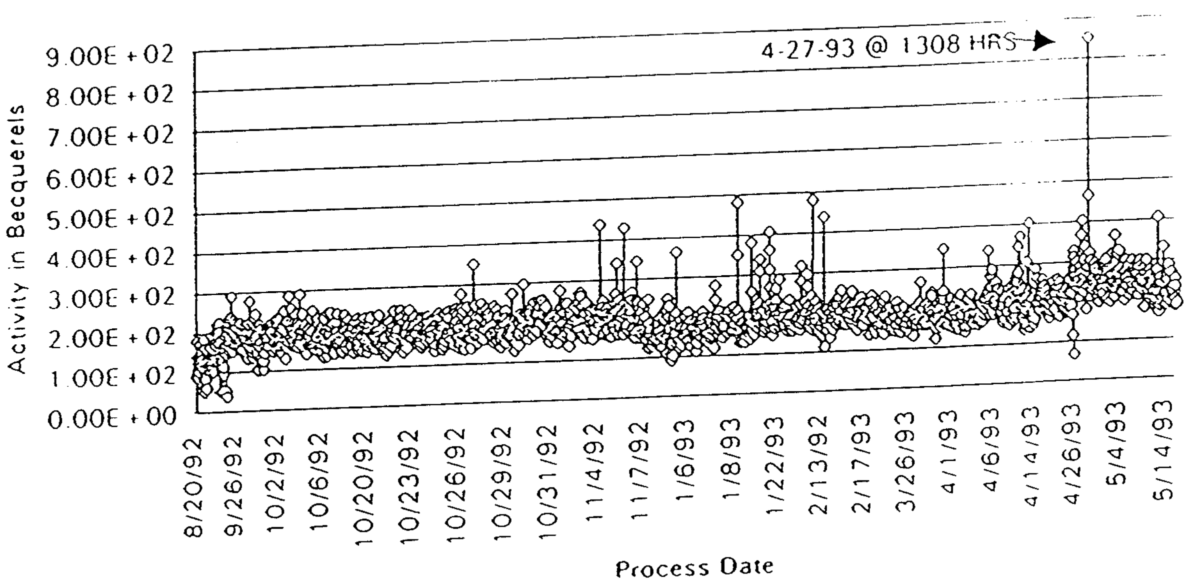

Figure 4-4. ESP/FIDLER survey data - clean soil pile.

including those with remaining useful life. TMA's plant operators have many years of experience as welders, machinists, heavy industrial mechanics, and heavy equipment operators. As the individuals who actually successfully accomplished the physical modification, fabrication, and erection of components of the Soil Cleanup Plant, TMA's staff are knowledgeable and experienced in the industrial and safety requirements of both plant component assembly and disassembly. TMA has effectively performed and documented detailed radiation clearance surveys at DOE and EPA sites throughout the United States. TMA plans to perform similar detailed surveys of removed plant components, decontaminate the components as required using simple, non-toxic methods available at JA (to avoid inadvertently producing a waste stream contaminated with both radioactivity and hazardous substances), document post-decontamination survey results, and provide detailed record of survey results to DNA for determination as to whether the component is suitable for release. At DNA's direction, TMA's staff will execute the decommissioning plan to culminate activities at project completion.

4.4 WASTE DISPOSAL.

As described in earlier reports (TMA 1992, TMA 1993), contaminated material diverted by the Segmented Gate Systems (both "hot" particles and distributed contamination) is routed to the contaminated soil conveyor. While still being tracked by the microprocessor system, the material proceeds to the "hot" particle gate. Here the material is further sorted, with the "hot" particles being directed to a drum and the material with distributed contamination being transferred to the day storage bin.

Because there are only about 50 drums on site available for the collection of "hot" particles, DNA early on directed TMA to empty filled drums into a "hot" particle holding pile. DNA established this pile within the LE-1 area. This area of the RCA is known to contain the highest levels of radioactive contamination. It is expected that DNA will direct TMA to reprocess this material in future using different, specialized system parameters to attain a significant additional volume reduction. As reported earlier (TMA 1992), TMA attained a further volume reduction (above the greater than 98% initial overall reduction) of approximately 80% in a previous evaluation with twelve drums of "hot" particle material. Concurrent with this effort, final assay of the waste material will be performed as the material is loaded into each DNA-provided disposal container. TMA's QA Technician will ensure that the assay of waste is accomplished according to the project QA Plan, TMA's supporting on-island procedures and checklists, and requirements of the DNA-designated waste disposal site. Plant operators will package waste soil for transport, and place it in dry cargo freight containers or other storage as directed by DNA. Samples will be maintained with chain-of-custody documentation as specified in existing corporate TMA procedures for all assayed waste, through packaging and placement in interim storage, and TMA will provide full documentation to DNA. TMA

staff will also prepare complete and accurate shipping papers as required to transport soil from JA. Radioactivity content of packages will be based on the results of waste stream assay, and completed shipping papers will be provided to DNA for authorized signature as shipper.

When so directed by DNA, TMA staff plan to prepare documents as necessary for compliance with waste disposal regulations at the DNA-designated disposal site that has agreed to accept the waste.

4.5 ENGINEERING DRAWINGS.

During Option Year 2, TMA verified that a complete set of engineering drawings, specifications, and plant information is being maintained on-site and notified DNA that this task had been accomplished. All drawings used for the construction and modification of the plant were inventoried and an updated index established. Whenever TMA or TCE modified existing drawings or completed new drawings, the drawings were field verified for overall accuracy. Old drawings were updated as necessary. Changes were hand-drawn on reproducible drawings and inserted into the on-island project documents. This information was sent to the off-island support engineering staff and incorporated into the drawing files on AutoCADD, Version 12. The drawing index list was updated to reflect the most recent drawing, and is included in APPENDIX G, DRAWING AND COMPUTER FILE LISTING. CADD drawing updates and revised drawing indices are forwarded to JA in an expeditious manner to assure complete copies of CADD drawings on-island. In addition, equipment, wiring and other devices that were still in place but not in use have mostly been removed. TMA intends that the drawing sets will fully depict the operational plant. To further enhance the value of the drawings, major equipment is in process of being tagged and cross referenced on the drawings. This system, similar to the tagging on the sorters, facilitates locating equipment from the drawings. APPENDIX H, PHYSICAL PLANT INFORMATION AND SPECIFICATIONS, contains summarized cleanup plant data.

SECTION 5

PROPOSED MODIFICATIONS AND IMPROVEMENTS

5.1 GENERAL DISCUSSION.

The evaluation factors for award of a new, future operating contract state that the major changes to the JA plant have already been implemented, and that only minor upgrades are expected from the operating contractor. It also states that the operating contractor is not expected or required to propose improvements.

Nevertheless, the TMA team recognizes that it is desirable to continually improve and upgrade the plant to increase productivity and reliability. In recognition of this goal, the following list of potential improvements to plant processes and equipment is proposed for DNA's review and consideration. Estimated costs for each proposed improvement task were included as options, subject to DNA approval, in the cost proposal submitted by TMA in accordance with DNA's RFP of 22 March, 1993 (see Section 6, REFERENCES).

It is the TMA team's belief that the Segmented Gate System of soil sorting, operated at times with modified operating parameters, will continue to be the primary method of volume reduction of contaminated soil on JA. TMA also feels that soil washing will continue to result in additional volume reduction. However, the proposed improvements may also be helpful in making the project even more successful. The intention of this list is to demonstrate to DNA the TMA team's commitment to continuous process improvement.

5.2 RECOMMENDATIONS.

5.2.1 Recommendation 1.

TMA recommends that DNA procure and install a 60-foot motorized belt conveyor to carry contaminated material away from beneath the existing Unit 1 and 2 "hot" particle gate, as previously specified by Thermo Consulting Engineers. This conveyor would replace the manually-operated drum roller conveyor presently in use for moving filled "hot" particle drums away from the area of the third gate. This improvement is desirable for two reasons. First, the conveyor installation would allow safer operating conditions for plant personnel and increased efficiency during "hot" particle drum transfers, reducing the need for assistance from other operators and personnel. Even though the roller conveyor is designed to support the effort, when highly contaminated material is processed the drums fill very quickly, and personnel are subject to rapid fatigue and dehydration in the high heat and humidity. Personnel have sustained muscular and skeletal back injuries from manually rolling heavy drums that weigh over 600 pounds along the roller conveyor, especially after becoming fatigued.

Second, due to the higher radioactivity levels anticipated during soil processing from the LE-1 area, more "hot" particle diversions are anticipated. This will result in an increased production rate of full 55-gallon "hot" particle drums. Drums may fill in a matter of seconds, overwhelming plant operators and likely requiring a production halt in order to move full drums away from the "hot" particle gate area.

5.2.2 Recommendation 2.

TMA recommends that DNA approve the modification of one 60-foot belt conveyor, presently on-site, to shorten it to 30 foot length. The 30-foot motorized belt conveyor would then be installed on Units 3 and 4 to efficiently move diverted contaminated material away from these sorters to the existing day bin feed conveyor.

5.2.3 Recommendation 3.

TMA recommends that DNA procure and install a 60-foot motorized belt conveyor at the end of the spiral classifier in order to remove washed material from the immediate vicinity and move it to an area where it can be easily accessed by heavy equipment.

5.2.4 Recommendation 4.

TMA believes that productivity of the soil washing process can be increased significantly over current capacity by modification of the soil and water mixing compartment and flow tube (immediately after the soil feed conveyor). TMA therefore recommends a relatively simple and inexpensive modification to the secondary plant to increase the capacity for feed material flow to the screw auger. This modification would require removal of the current tube and replacement with an open trough that can be designed and fabricated by the current on-site plant operators. Cost is estimated to be minimal, and the recommended modification would require approximately one week.

5.2.5 Recommendation 5.

As the overall plant capacity is increased by the operation of two additional sorting lines on Units 3 and 4 and the proposed increased rate of soil processing through the wet end (see Section 5.2.4), the labor demands for plant personnel will also increase. The critical functions of supplying the plant with sufficient feed material to support continuous processing and moving the processed material are limiting factors. TMA offers to utilize our corporate contacts in the Department of Defense to locate a surplus front end loader and dump truck. TMA highly recommends that DNA acquire any additional equipment so identified to ensure adequate operating contractor capacity to move material on the site.

5.2.6 Recommendation 6.

The JA soil processing site has been plagued with power outages. These outages, often extending for many hours, have disrupted operations. TMA will determine the required size diesel generator or generators necessary to operate the plant. TMA will attempt to locate surplus generators within the DoD system (see section 5.2.5), and highly recommend that DNA acquire any equipment so identified in order to improve plant operating performance.

5.2.7 Recommendation 7.

TMA/Eberline highly recommends that DNA procure the spare parts listed below to minimize plant downtime and enhance overall production:

Item	No.Requested	Estimated Cost
Master Controller Board (FP24C)	1	$930
Detector Boards (FP17D)	6-10	$885 each
Background Board (FP17E)	1	$885
Conveyor Detectors (RDA8A)	2	$1375 each
Eberline ESP-2	1	$1045
Bicron FIDLER	1	$3000
Copy Machine	1	$4000
Waste Containers/Shipping Materials	TBD	

5.2.6 Recommendation 6.

The Occupational and Environmental Radiation Protection Engineering Facility Advisor at the University of New Mexico (UNM) has expressed an interest in working with the DNA Project Manager to offer health physics graduate students opportunities for research studies to assist the JA Soil Cleanup Project. This UNM Practicum program is intended to provide the students with practical experience in health physics, environmental monitoring, radiation monitoring, and other fields. TMA highly recommends that DNA become a participant in this program at the JA site. The benefit to DNA is two-fold:

- The DNA Project Manager at Field Command can work directly with the students and faculty advisor at UNM to identify areas of study important to the project. One example of such a study is to determine the optimum thickness of soil on the counting belt as discussed in Section 5.2.12, above.

- The graduate students are normally not compensated for their time devoted to Practicum, traditionally about a 3 month period. It is presumed that travel and subsistence expenses would be the only expenses incurred by the project for this support. It is believed, therefore, that support of this

program would economically benefit UMN, DNA, and the project overall.

5.3 OPTIONS.

5.3.1 Option 1.

TMA proposes for consideration an optional modification to the source code by Eberline Instrument Corporation (EIC) to obtain one-second (instead of the current 2-second) diverts for "hot" particles in the 5,000 - 20,000 Bq range. This modification is expected to reduce the volume of clean soil with each "hot" particle divert by a factor of two. The new algorithm will employ an 8 by 80 (instead of the current 8 x 10) matrix composed of 0.25 second elements taken from detectors one through eight. A "hot" particle will be flagged in the elements per the status information from the front and back row of detectors. The demand on the processing time is such that even the previously proposed central processing unit (CPU) does not have sufficient speed to handle the new calculational overhead. Therefore, a fast industrial personal computer (PC) would be required for use with the required software to enable it to perform the functions of the original master controller. With this configuration, the ability to simultaneously use the portable lap top PC and the Control Room PC would be no longer available. Only one or the other will be able to be used at a time. This proposal does not entail increasing the processor speed or baud rate in the detector boards. The detector boards would not control the diversion gates.

5.3.2 Option 2.

TMA proposes for DNA consideration the possible option of sorting "hot" particles across the belt, perpendicular to belt direction, to determine the horizontal position of a "hot" particle in the 20,000 - 1,000,000 Bq range. To accomplish this task, a modified "hot" particle routine based on distance rather than time data would be developed by EIC. The intent of this option is to reduce the amount of material which is presently diverted because of adjacent detectors responding to the "shine" from a "hot" particle not actually beneath them.

5.3.3 Option 3.

The JA Central Computer currently generates ASCII log files for use by an external Symphony spreadsheet program to generate a daily plant log summary for each operating sorting system. To use the spreadsheet program, the operator must first import an individual log file into the spreadsheet program and then manually remove transactions generated during source checks before executing the macros to generate a report. Data from each operating sorter system must be separately processed through the spreadsheet program. TMA proposes development of an optional report generator module to be added to the existing JA Central Computer software to enable the operator to generate a daily report (for the current day or any previous operating day) for

any selected conveyor. The generated report will have the same information currently provided by the two page report generated by the spreadsheet program. The system does not now log distributed or particle transactions when the system is in maintenance mode. The current requirement to manually edit some logged transactions results from performing source checks while operating the system in normal run mode during actual soil processing. Since it is considered desirable to generate log transactions during the process of source checking the system, it may be necessary to alter the way in which these checks are handled. First, the current practice of disabling log transactions during maintenance mode operation will be stopped. Instead, log transactions (both particle and distributed) will be given a status field enabling the report generator to identify and include in the daily report only those transactions generated when the system is in a normal operating status. The only requirement will be that the system operator make sure the conveyor is in the maintenance mode status prior to initiating source checks. A menu item will be added which will enable the operator to generate the daily report for any selected conveyor, for any selected day. The only restriction on report generation is that the conveyor systems be in a pause mode prior to generating reports. This restriction prevents the Central Computer from missing log data while the reports are being generated. Note that an up-to-the-minute two page report of the processing totals for a given day can be generated any time the systems are paused for a break. To facilitate rapid report generation, reduced disk storage space and improved logging performance, the logging transactions will be stored in a binary format instead of the ASCII format currently employed. A report generation menu selection will support manual generation of an ASCII format log file and/or report should this format be desired for another purpose.

5.3.4 Option 4.

TMA/Eberline proposes to operate the crusher with the addition of one operator. For this option, TMA anticipates operating the crusher for one week per operating month to provide material for Units 3 and 4. This should provide enough crushed coral (approximately 900 tons) to be processed through Units 3 and 4 each week for three weeks. The same operator would also be identified to deliver crushed material to Units 3 and 4 pending locating and obtaining an additional front-end loader. This is based on an average crusher output of 25-50 tons per hour.

5.3.5 Option 5.

A preliminary study of the soil mass attenuation coefficient by TMA in March, 1993, under the guidance of the DNA Project Manager, indicates that the soil thickness on the feed belt could be increased from the current 0.75 inch. Using the measured mass attenuation coefficient of 0.298 cm^2/g, a maximum self attenuation of 1/e, and an assumed soil density of 1.15g/cm^3, the thickness of material on the belt could be increased to 1.15

inch. This increase in soil thickness would then increase plant throughput by 53%.

It is difficult not to endorse a modification like this that would increase plant production so significantly. However, additional discussion is necessary with the DNA Project Manager to discuss the following:

- Increasing the belt soil thickness will increase the chance of missing a "hot" particle.

- The allowed soil thickness is dependent upon soil density. As the density increases, the thickness must be reduced.

At this time, the TMA team recommends additional testing of the optimum thickness of soil on the belt to maximize production rates while considering system detection capabilities. This data will be discussed with the DNA Project Manager to select the preferred operating parameters.

5.4 ALTERNATIVE TECHNOLOGIES.

In the event application of the Segmented Gate Soil Sorting System and the current supplementary soil washing system are not fully successful to satisfactorily clean all JA soil, the TMA team includes specialists in mineral recovery processing. The team member with this expertise, Arrakis, Inc., is currently under contract with DOE to demonstrate two promising methods of separating radioactive contaminants from host soil. These two processes are described below. Arrakis can evaluate the applicability of these processes to JA soil to potentially enhance the overall volume reduction of contaminants.

5.4.1 Paramagnetic Separation.

Magnetic and paramagnetic separation is a technology which has been used for many years in the mineral processing industry for the separation, concentration and refinement of a wide variety of mineral compounds. Specifically there are paramagnetic plant installations worldwide which process hundreds of tons per hour of silica sands, kaolin clays, and rare earth and superconductor materials, at very high removal efficiencies. Recent developments in the design and construction of neodymium-boron-iron rare earth magnets have greatly enhanced the application and efficiency of this mature technology. This technology could be very cost effectively added to the discharge end of the existing sorting system at JA. This is a technology which TMA will examine to enhance the performance of the existing system, should it become necessary on higher activity soils.

When subjected to a magnetic field, all particles will respond in a particular manner and can be classified as one of three groups: ferromagnetic, paramagnetic and diamagnetic. Materials that have a very high magnetic susceptibility and are strongly induced by a magnetic field, such as iron, are termed ferromagnetic. Iron, nickel and cobalt are all ferromagnetic elements. Materials that

have a low magnetic susceptibility and a weak response to a magnetic field are paramagnetic. Many ferrous alloys like stainless steel, several varieties of iron bearing minerals as well as uranium and plutonium compounds are classified as paramagnetic. Materials with a negative magnetic susceptibility are diamagnetic and for all practical purposes are non-magnetic.

Ferromagnetic, and to a lesser extent paramagnetic materials, will become magnetized when placed in a magnetic field. The amount of magnetization induced on the particle depends on the mass and magnetic susceptibility of the particle and the intensity of the applied magnetic field.

In the design of a magnetic separator, the magnetic field intensity and the magnetic field gradient are two first-order variables that affect separation response. The intensity of the magnetic field refers to the number of lines of flux and are measured in gauss (1 line per centimeter [cm]). High intensity magnetic separators typically operate in regions over 5,000 gauss. The magnetic field gradient refers to the rate of change or the convergence of the magnetic field strength.

There are two common methods for a magnetic gradient in a separator. The first method, which is typical of magnetic circuits utilizing permanent magnets is to concentrate the lines of flux on a steel pole piece within the circuit. This can be accomplished simply by placing a steel pole piece between two magnets. The magnetic flux will be concentrated in the steel pole piece resulting in an area of extreme magnetic field intensity. The second method involves placing a steel matrix, such as a metal mesh, directly in a uniform magnetic field and converges the lines of flux to produce localized regions of extremely high magnetic field intensity.

The evolution of permanent magnets has provided a cost effective alternative for the generation of high intensity magnetic fields. Specifically, in recent years, the strength of permanent magnets has increased several fold with neodymium-boron-iron rare earth magnetics now producing an energy product of 35 million gaussoersted. The development of these rare earth magnets has led to the design of magnetic circuits possessing a magnetic attractive force an order of magnitude greater than that of conventional permanent magnet circuits. The High Gradient Magnetic Separator (HGMS) is the most advanced separator using this newly developed technology.

Initial results of testing utilizing wet paramagnetic separation for plutonium removal from soil by Los Alamos National Laboratory (LANL) have shown to be very promising.

5.4.2 Chemical Extraction.

Recent soil washing/chemical extraction tests conducted on the DOE Mound Laboratory soils, demonstrated that a proprietary halogen salt compound removed plutonium from fine grained soil at a 97% removal efficiency. This was accomplished at ambient

temperature and pressure and low retention times with a recoverable, recyclable chemical. Arrakis personnel have used this same reagent on a "clean" sample of JA coral to verify that it does not dissolve the matrix. The results of these two tests indicate that the proprietary halogen salt compound salt should remove the plutonium oxide from JA coral soils at a very high efficiency without dissolving the coral matrix and with minimal secondary waste streams.

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